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MACHINERY

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The Monthly Magazine of Engineering and Production in the Manufacture of Metal Products

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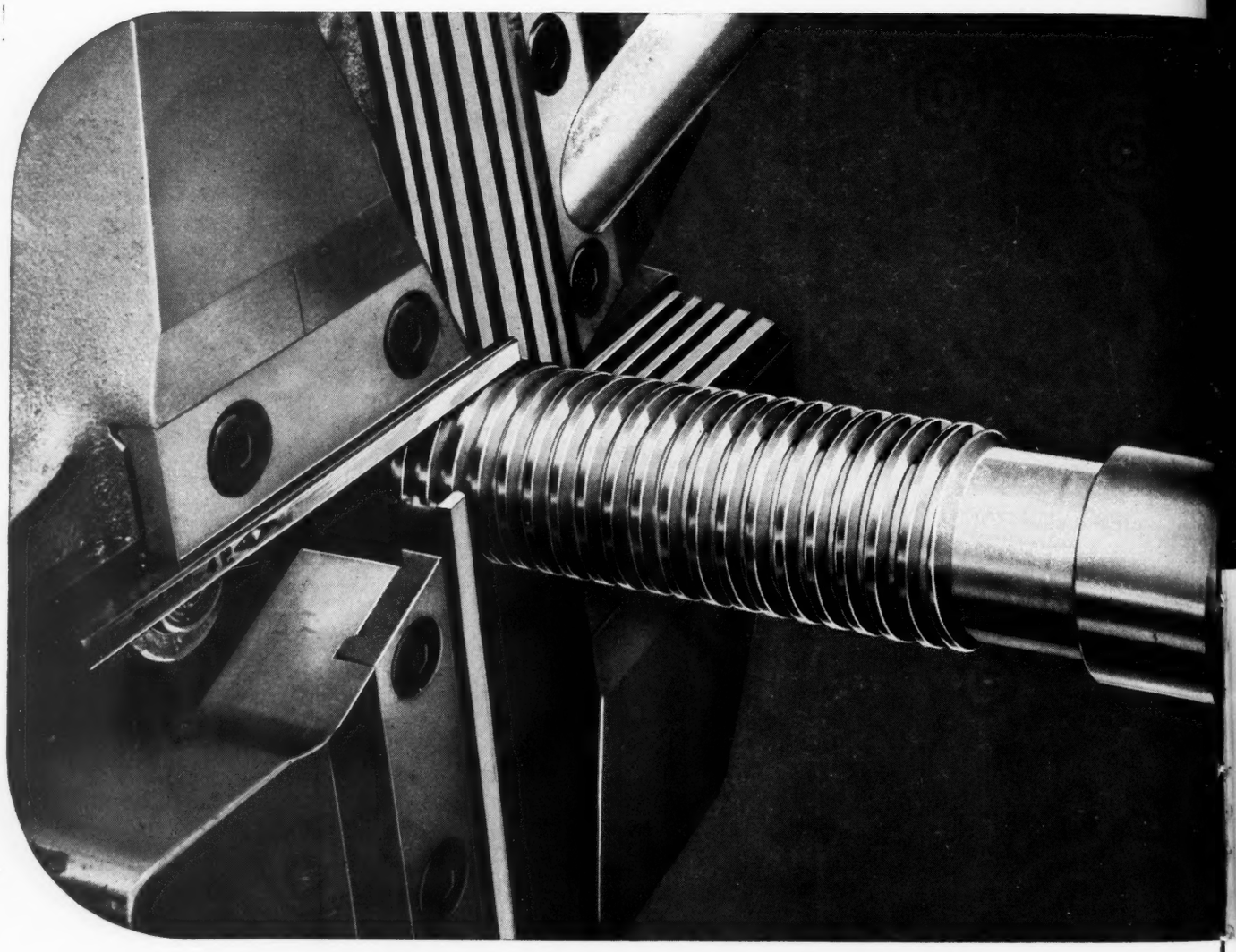
The LANDIS

THE FINEST THREAD–



ABOVE: 1⅝" diameter 4 pitch right- and left-hand Acme threads are cut 5¼" long on opposite ends of vise screws in one pass using a LANDMACO Single-Head Threading Machine equipped with Leadscrew Attachment. In finishing 12.9 pieces per hour, the machine operates at a cutting speed of 24 surface feet per minute. The 4.66 minute operation formerly required 79.74 minutes.

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MACHINERY
Vol. 56 JUNE, 1950 No. 10

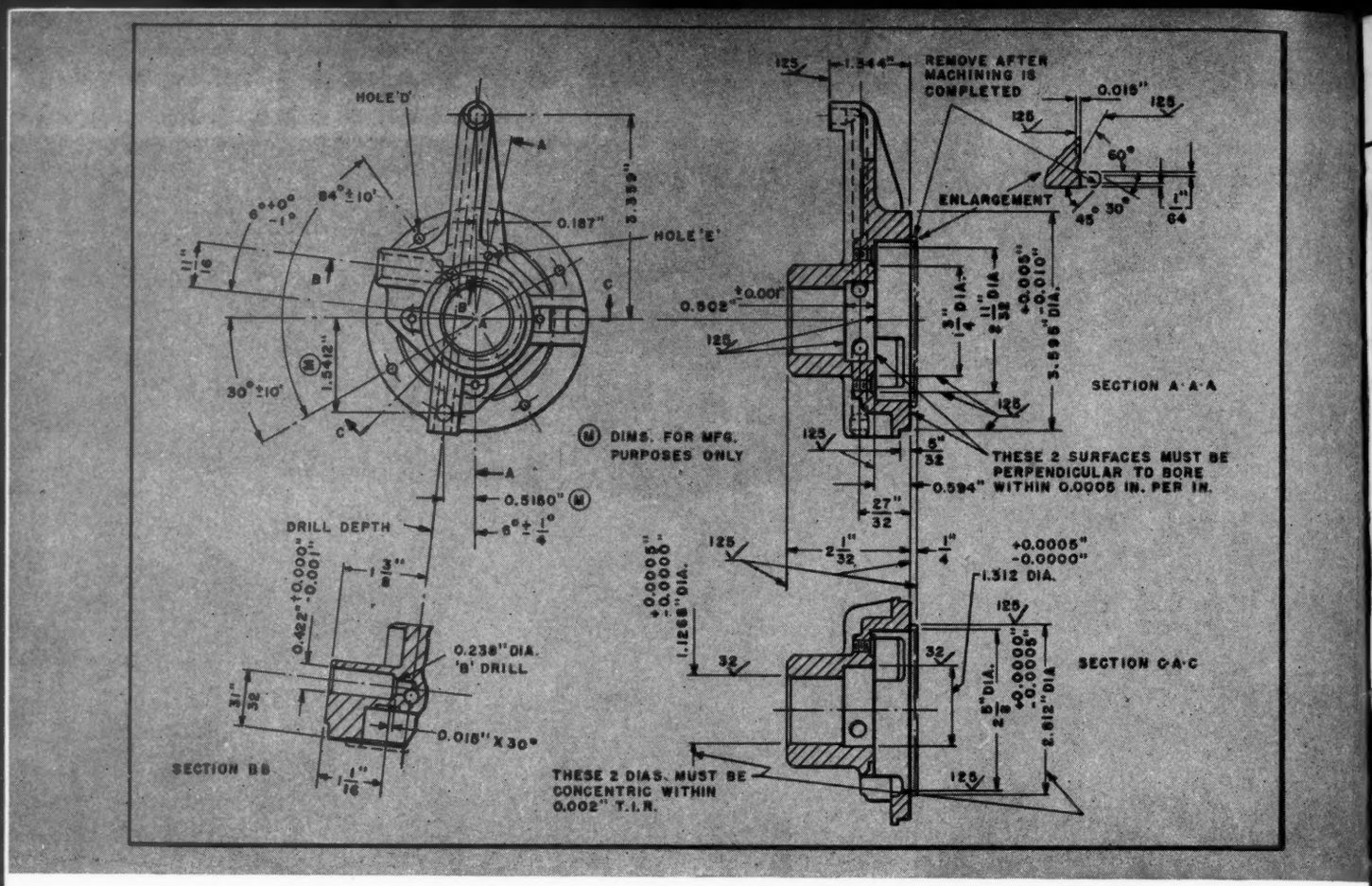
Hydraulically Operated Machines Make Electric Washers

Accuracy and High Production Rates are Achieved by Automatically Machining Cast Parts for General Electric Washers in Specially Designed Hydraulic Machines

By JAMES A. SMITH
Supervisor of Planning
Trenton Works, General Electric Co.

SINGLE-PURPOSE equipment is used extensively in manufacturing components of automatic washing machines at the Trenton, N. J., plant of the General Electric Co. Many of the principal parts of these washers are completely processed from rough castings to the semi-finished machined stage in electrically controlled, hydraulically operated machines designed and built especially for these parts by W. F. & John Barnes Co., Inc., Rockford, Ill.

The machines are set up for automatically performing drilling, reaming, tapping, facing, boring, milling and other machining operations on such cast parts as the lower bearing hub, gear-case, bearing frame, gear-case cover, and balance-ring hub. Trunnion type fixtures especially



designed for each part are used on the various machines. A vertical, center-column type machine for roughing and semi-finishing the lower bearing hub, Fig. 1, is shown in the heading illustration.

This machine has twelve stations in which fifty-seven tools, including various sizes of drills, taps, reamers, counterbores, turning and facing tools, and other combination tools are used. At each station there are two vertical multiple-spindle heads, which divides the machining cycle into two settings, so that one complete rotation of an automatic indexing table (on which the work is carried from station to station) provides for the complete machining of one side of the part. As the work that is finished on one side returns to the loading and unloading station, it is removed from the fixture, turned over and replaced, to continue around once more for machining the opposite side in the second setting.

Four self-contained, horizontal, sliding head units are provided for drilling and reaming holes in the sides of the hubs. Each of the vertical and horizontal heads can be operated independ-

Fig. 1. (Above) High production rates and close tolerances are maintained in completely machining this cast-iron bearing hub in a special hydraulic machine and a precision boring machine

Fig. 2. (Left) Trunnion type fixtures on an automatically indexing rotary table are loaded and unloaded manually at the twelfth station of the special machine shown in the heading illustration

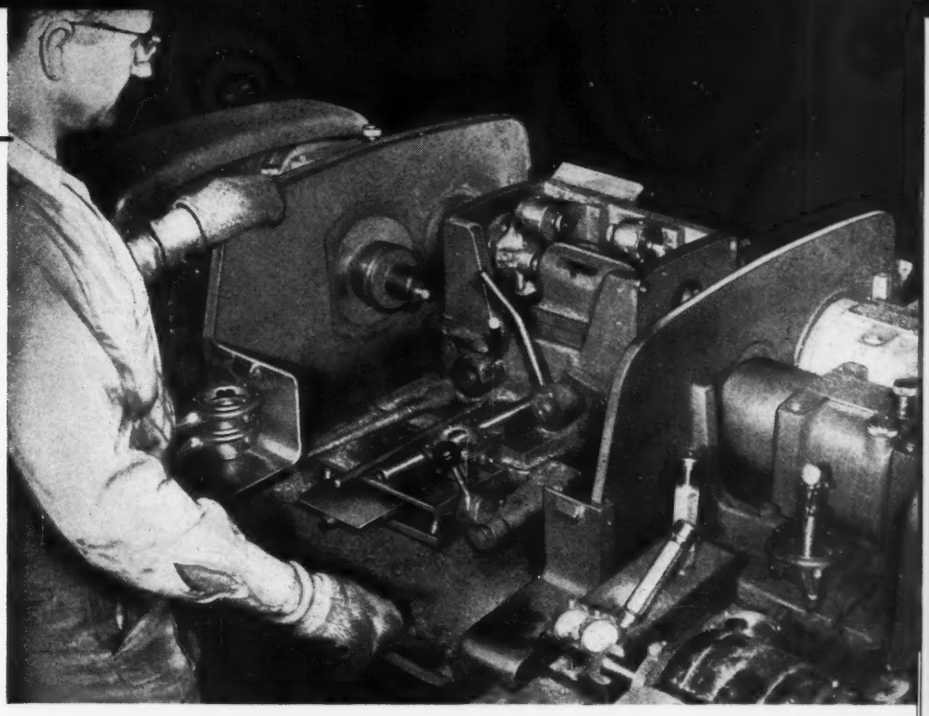


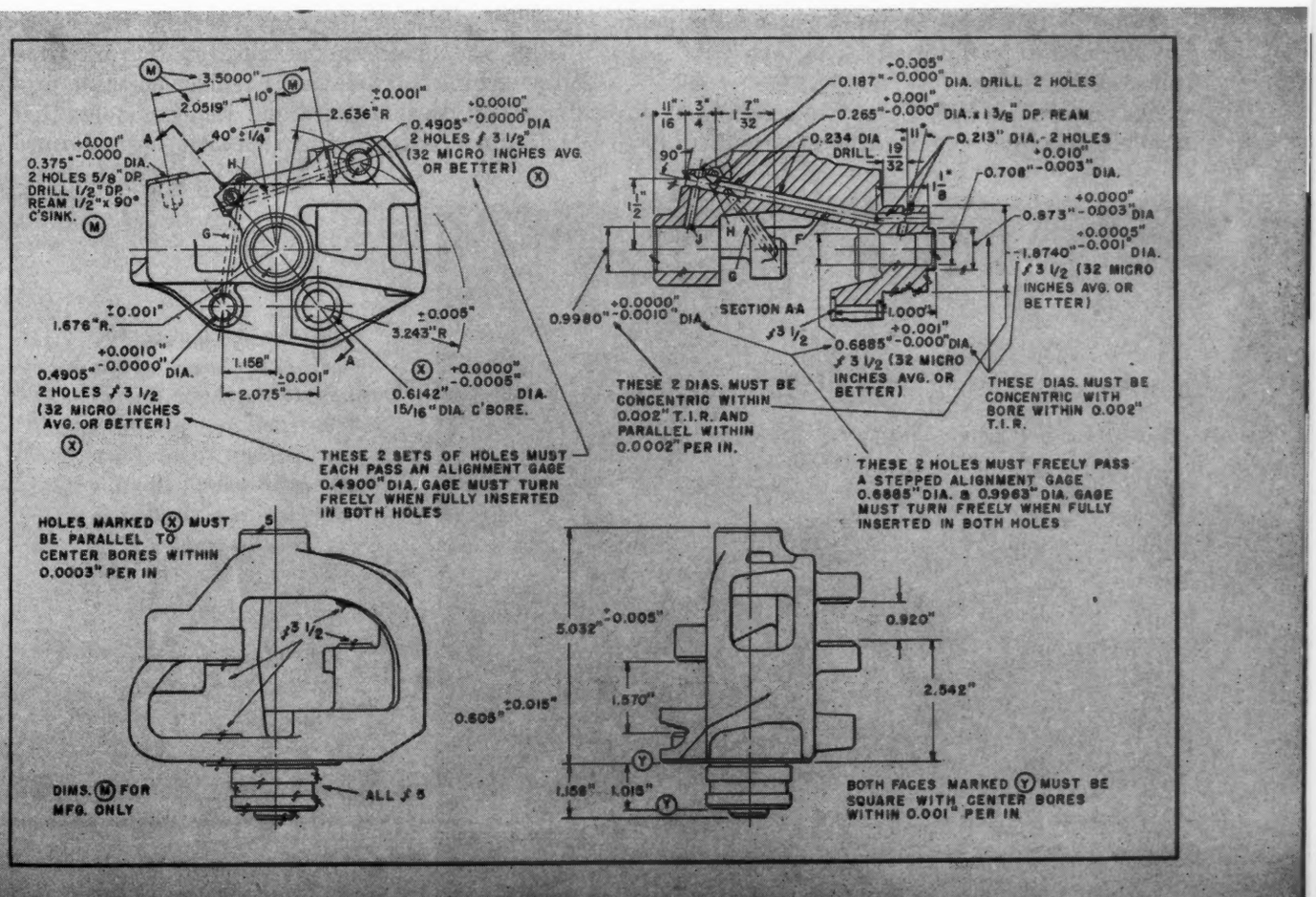
Fig. 3. (Right) A four-spindle, double-end Heald Bore-Matic is used to finish-machine the bearing hubs. Carbide tools are employed, and the parts are faced and bored to a tolerance of 0.0005 inch

Fig. 4. (Below) This cast-iron gear-case is drilled, faced, milled, reamed, chamfered, grooved, and tapped by four hydraulic single-purpose machines

ently—a condition that is advantageous when setting up the tools. In the normal operation of the machine, however, all heads are fed simultaneously, although some feed into the work ahead of others to eliminate vibration and tool chatter. Various rates of feeds can be obtained by adjusting hydraulic feed valves at each station. As much as 0.040 inch of stock, including scale, is removed from the lower bearing hub in some of the operations that are performed in this machine.

At the loading station, the work is manually clamped in the fixture, Fig. 2, after which the table automatically indexes to Station 1. Here, in the first setting, a combination facing and turning tool with carbide blades and an inserted head for counterboring and trepanning is used, together with four high-speed steel drills. At the same time, six additional high-speed steel drills are fed into the sides of the work from a horizontal sliding head unit.

At the next station, another combination cutter-head with carbide blades turns and chamfers the work. At Station 3, nineteen holes are drilled



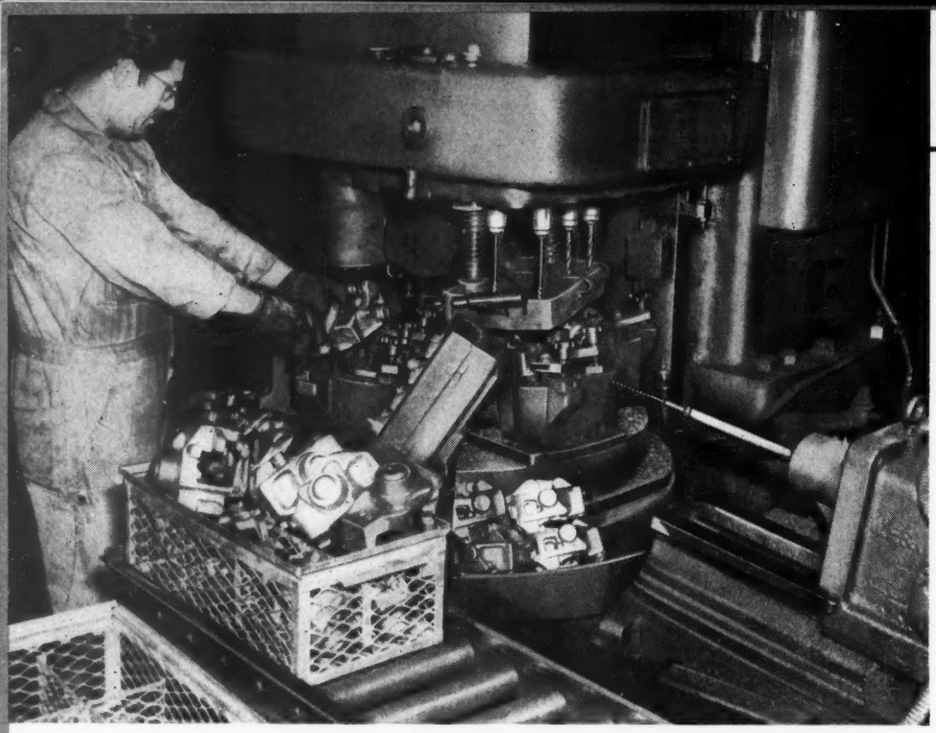


Fig. 5. The first of the four special machines used for machining gear-cases produces working surfaces and locating holes for subsequent operations. At the first of five stations, the work is loaded manually in fixtures on a rotary indexing table

by high-speed steel drills. These holes include a center bearing hole, one oil-hole, and four mounting holes. Similar operations, using carbide and high-speed steel tools throughout, are performed at the remaining stations in both the first and second settings.

Upon completing the machining cycle in the second setting, the semi-finished work is placed in pans on a gravity-feed roller conveyor adjoining the machine. This conveyor carries the hubs to a double-end, four-spindle Heald Bore-Matic where they are finish-machined. The operations performed in this machine consist of facing the seat for a thrust plate, finish-boring the pump cavity, and finishing the bearing hole to a tolerance of 0.0005 inch.

As shown in Fig. 3, a two-position fixture travels from left to right and from front to rear to align the work with the four heads on this machine. The same operations are performed by the heads on the left as by the right-hand heads. Tools in the front heads finish-bore the 1.1268-inch diameter hole, while those in the rear heads bore the 1.312-inch diameter hole and, at the same time, face two inner surfaces parallel with the flange and remove a lip used for locating purposes in the hydraulic machine previously described.

A line of four special W. F. & John Barnes Co. machines is used for machining the cast-iron gear-case housing shown in Fig. 4. A gravity-feed, double-tier roller conveyor runs the length of this line, speeding the transfer of work from one machine to another. The first machine produces working surfaces and locating holes that facilitate the machining operations performed

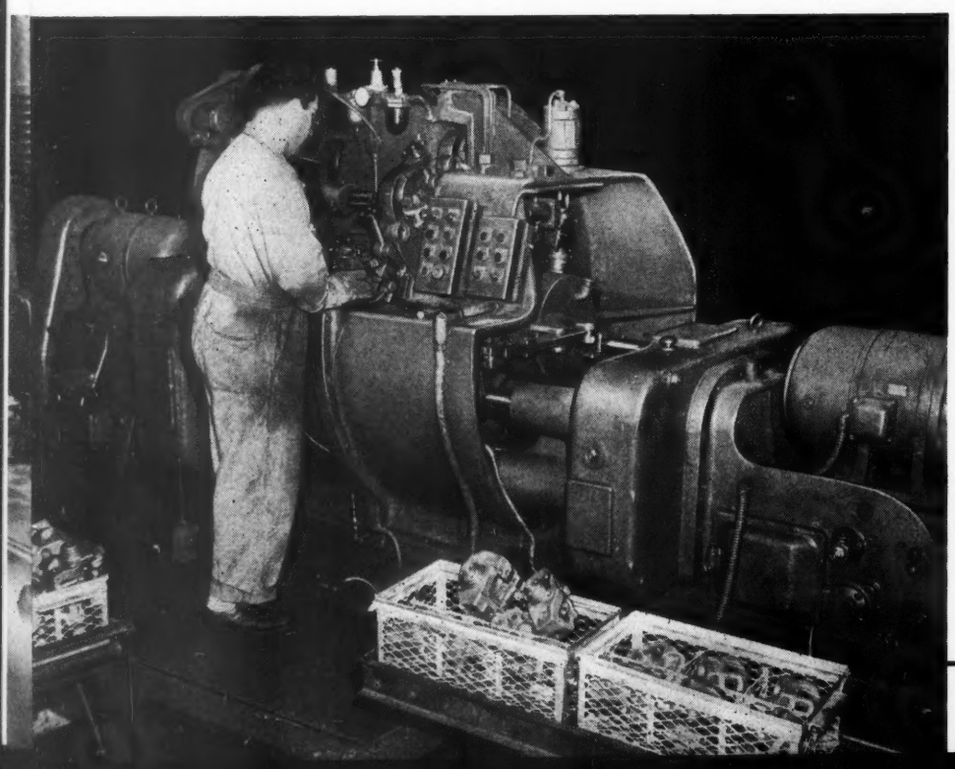


Fig. 6. A ten-station, horizontal machine is the second in a line of four used for performing various operations on gear-cases. In this machine the parts are rough-machined

Fig. 7. Three auxiliary units, including two horizontal sliding heads and an angular head, are provided in this vertical type, multiple-spindle machine, which is the third of four special machines that are used for machining gear-cases

in the other three machines of the gear-case housing line.

At the first of five stations, Fig. 5, the work is loaded and unloaded manually in fixtures on an automatic, hydraulically operated, rotary indexing table. Three bosses are faced at the second station, using a cutter with carbide blades. At Station 3 a cut is made between the bosses with a carbide milling cutter, and two 3/8-inch diameter locating holes are drilled. These holes are chamfered at the fourth station and an oil-hole is produced, while at Station 5, the locating holes are reamed.

Using the working surfaces and locating holes produced in the first machine, the work is loaded manually in the second machine for rough-machining operations and for producing all the holes for the shafting in the gear-case. Indexing from one to another of the ten stations provided is completely automatic.

This machine, Fig. 6, is of the duplex, horizontal type, having a twenty-spindle, left-hand head, detachably mounted on a sliding unit, and a nine-spindle, right-hand head, similarly mounted. At the first station, four high-speed steel drills are used in the left-hand head to produce one 21/32-inch diameter hole, two 15/32-inch diameter holes, and one 37/64-inch diameter hole. Meanwhile, the right-hand head is used to drill a 5/8-inch diameter hole.

High-speed steel reamers in the left-hand head are used at the second station to ream the four holes drilled at Station 1. Simultaneously, a 61/64-inch diameter high-speed steel drill is em-

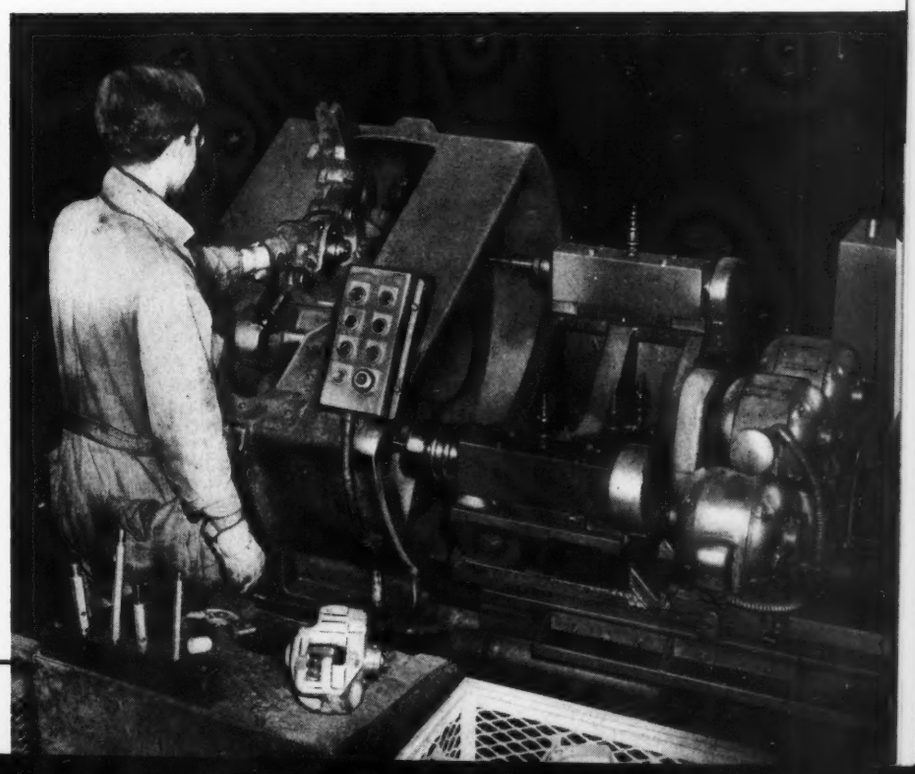
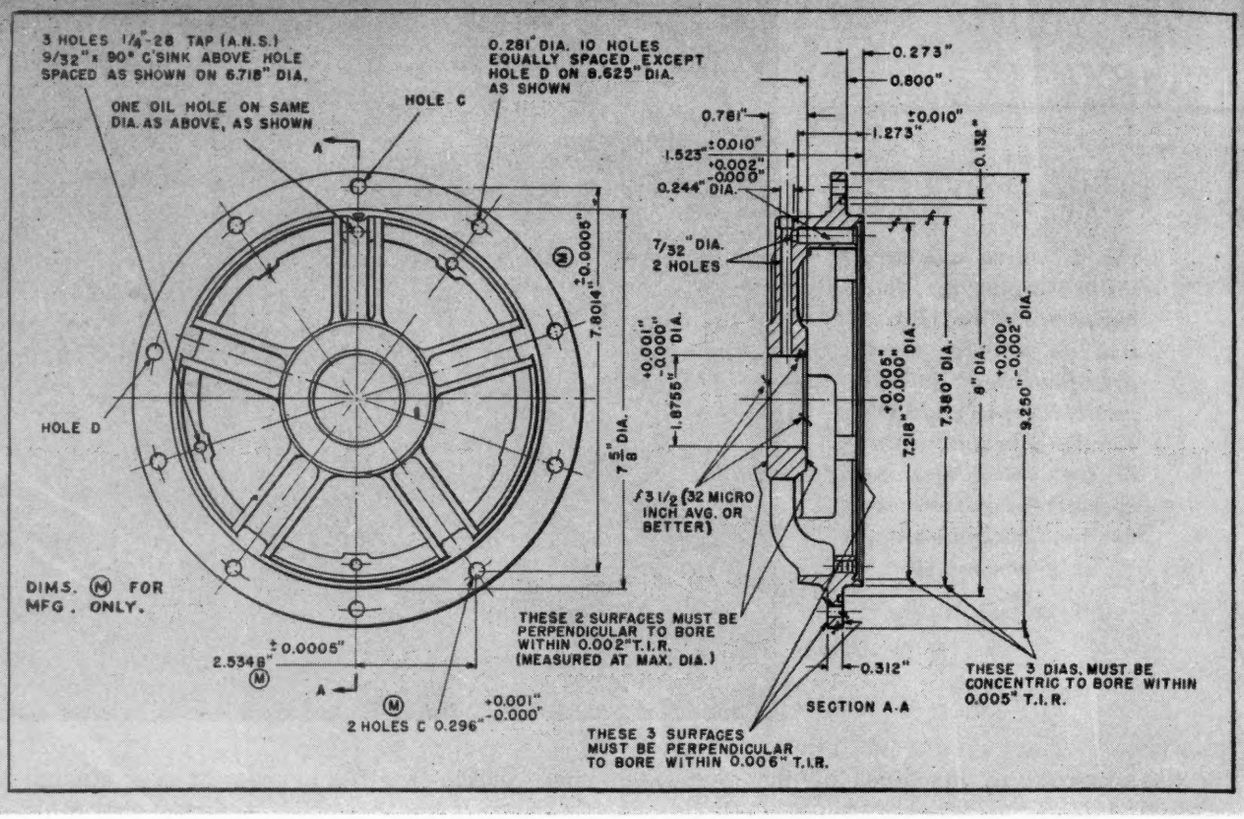


Fig. 8. All the holes that were rough-bored in the gear-case in the second machine are finish-bored in the double-end, four-station, horizontal machine here illustrated


3 HOLES 1/4"-28 TAP (A.N.S.)
9/32" x 90° C'SINK ABOVE HOLE
SPACED AS SHOWN ON 6.718" DIA.
ONE OIL HOLE ON SAME DIA. AS ABOVE, AS SHOWN
HOLE C
0.281" DIA. 10 HOLES EQUALLY SPACED EXCEPT HOLE D ON 8.625" DIA. AS SHOWN
HOLE D
DIMS. Ⓜ FOR MFG. ONLY.
2.5348" ±0.0005"
2 HOLES C 0.296" +0.001" -0.000"
THESE 2 SURFACES MUST BE PERPENDICULAR TO BORE WITHIN 0.002" T.I.R. (MEASURED AT MAX. DIA.)
THESE 3 SURFACES MUST BE PERPENDICULAR TO BORE WITHIN 0.006" T.I.R.
SECTION A-A
0.273"
0.800"
0.781"
±0.010"
1.273"
1.523" ±0.010"
0.244" DIA. +0.002" -0.000"
0.132"
7/32" DIA. 2 HOLES
7.8014" ±0.0005"
7 5/8" DIA.
+0.0001" -0.0000" DIA.
1.8755"
+0.005" -0.000" DIA.
7.218"
7.380" DIA.
8" DIA.
+0.000" -0.002" DIA.
9.250"
0.312"
THESE 3 DIAS. MUST BE CONCENTRIC TO BORE WITHIN 0.005" T.I.R.
32 MICRO INCH AVG. OR BETTER

ployed in the right-hand head to enlarge the 5/8-inch diameter hole. Two 15/32-inch diameter drills are also used at this station in the right-hand head. Tools at the remaining stations, up to and including the ninth, mill, face, groove, drill, chamfer, and tap these parts in a similar manner, except that, in some cases, the right-hand head is idle. Using carbide and high-speed steel tools, a high production rate is obtained.

The third machine in this line is of the multiple-spindle, vertical type, and has three auxiliary units, including two horizontal sliding heads and one angular head, Fig. 7. A fully automatic, hydraulically operated, 48-inch diameter rotary indexing table contains seven work-holding fixtures for carrying the gear-cases to each of the seven stations in the machine. Clearances for the various gears are milled in the case, as well as the remainder of the oil-holes used for lubricating the gears. Carbide milling cutters and high-speed steel drills and reamers are employed for these operations.

All the holes that were rough-drilled in the second machine are finish-bored in the fourth, Fig. 8. This is a horizontal, double-end, precision boring machine containing four stations. A center base carries four manually indexed work-holding fixtures. Three precision spindles are employed in one head and four in the other.

At the first station, tools in the left-hand head

Fig. 9. (Above) This cast-iron bearing frame is rough- and semi-finish machined in a five-station, vertical machine having two horizontal sliding heads for drilling and reaming an oil-hole in the side

Fig. 10. (Left) The machining cycle for the bearing frame shown in Fig. 9 is divided in this special machine so that one side of the work is completely machined in one rotation, after which the part is turned over for machining the opposite side during a second rotation

Fig. 11. Bearing frames are finish-machined in a four-spindle double-end Heald Bore-Matic. Work is loaded and unloaded at one end while the heads at the opposite end are performing the machining operations

bore one hole 0.9980 inch in diameter within a tolerance of 0.001 inch, while a combination turning and boring tool in the right-hand head bores a hole to 0.6885 inch in diameter, maintaining the same tolerance, and at the same time turns a 1.8740-inch diameter within limits of plus 0.0005 inch minus 0.001 inch.

Two holes, 0.4905 inch in diameter, are bored at Station 2 with tools in the left-hand head to a tolerance of 0.001 inch. At the same station, tools in the right-hand head bore two other holes to the same dimension and the same tolerance.

At the third station, the left-hand head is idle, and tools in the right-hand head bore one hole to 0.6142 inch, maintaining a tolerance of 0.0005 inch. At Station 4, the work is loaded and unloaded.

Castings for the bearing frame shown in Fig. 9 are turned, bored, faced, drilled, and tapped in the vertical machine illustrated in Fig. 10. This machine has five stations, to which the work is carried on an automatic rotary indexing table. The machining cycle is divided into two settings in the same manner as that described for the machine in which the bearing hubs are processed. As in that procedure, the work completes one rotation, being machined on one side at the first setting, and is then turned over for machining the opposite side at the second setting. Two horizontal sliding heads are provided for drilling and reaming an oil-hole in the side of the part.

In the first setting, at Station 1, the outside diameter is rough-turned, the flange rough-faced and chamfered, and the outside diameter of the ribs turned. This surface of the ribs is used for locating the part when it is turned over for machining the opposite side.

At the second station, the center hole is rough-bored, the hub faced, and an oil-hole drilled in the side, using one of the horizontal sliding

Fig. 12. This four-station, double-end boring and facing machine is the first of two used for machining aluminum die-cast balance-ring hubs. The work is loaded manually in fixtures on an automatically indexing rotary table

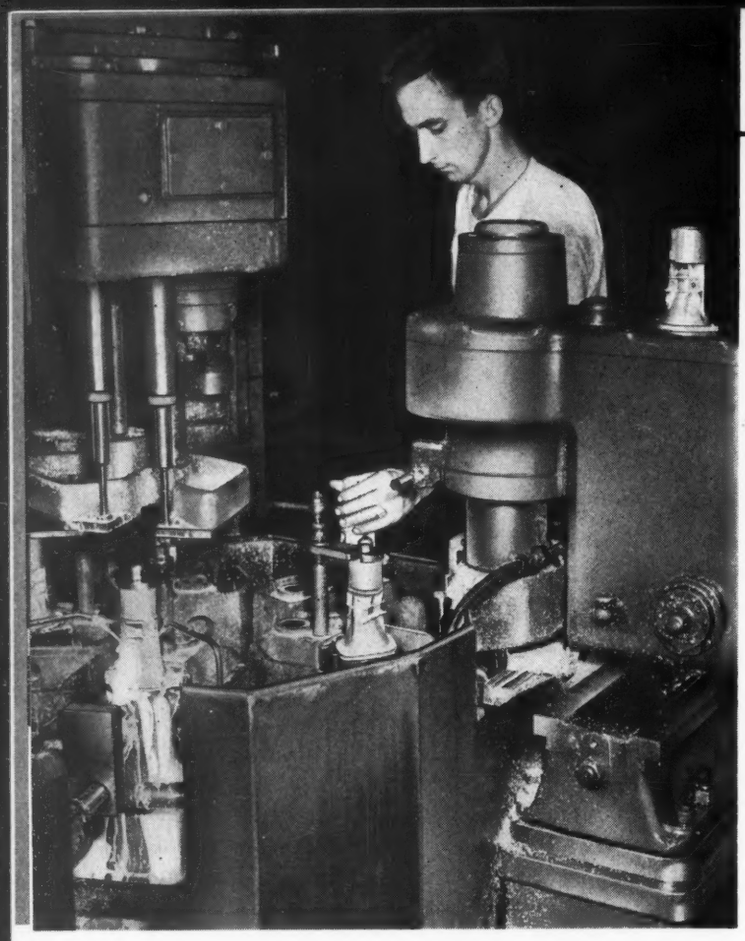


Fig. 13. Balance-ring hubs are drilled, chamfered, tapped, and milled in this five-station machine. A horizontal sliding head unit is used to drill two holes in the side of the part

heads. The bore is semi-finished at the next station and ten holes, 0.281 inch in diameter, are drilled and chamfered in the flange. A horizontal sliding head unit is employed at Station 4 for reaming the oil-hole produced in the side of the bearing frame at the second station.

After this operation, the work is turned over and passes through the machine again for drilling, tapping, chamfering, turning, facing, and boring in the second setting. In this machine, as in the others described, carbide and high-speed steel tools are used at all working stations.

To insure dimensional accuracy before finish-machining these bearing frames, a percentage of the work is inspected at the machine. Following these operations, the semi-finished parts are transferred to a Heald four-spindle, double-end Bore-Matic for finish-machining. A gravity-feed roller conveyor is used for this purpose.

Two toolposts are located at each of the four heads on this machine, Fig. 11. One of these is tooled to finish-bore the center hole and at the same time straddle-face the hub. The other toolpost contains tools for turning the outside diameter of the part and straddle-facing and chamfering the flange. Since the machine table traverses to the left and to the right, the operator is able to load and unload the fixtures at one end while the work is being machined in the heads at the opposite end of the machine.

Fig. 14. Zinc die-cast gear-case covers produced by the use of four special machines

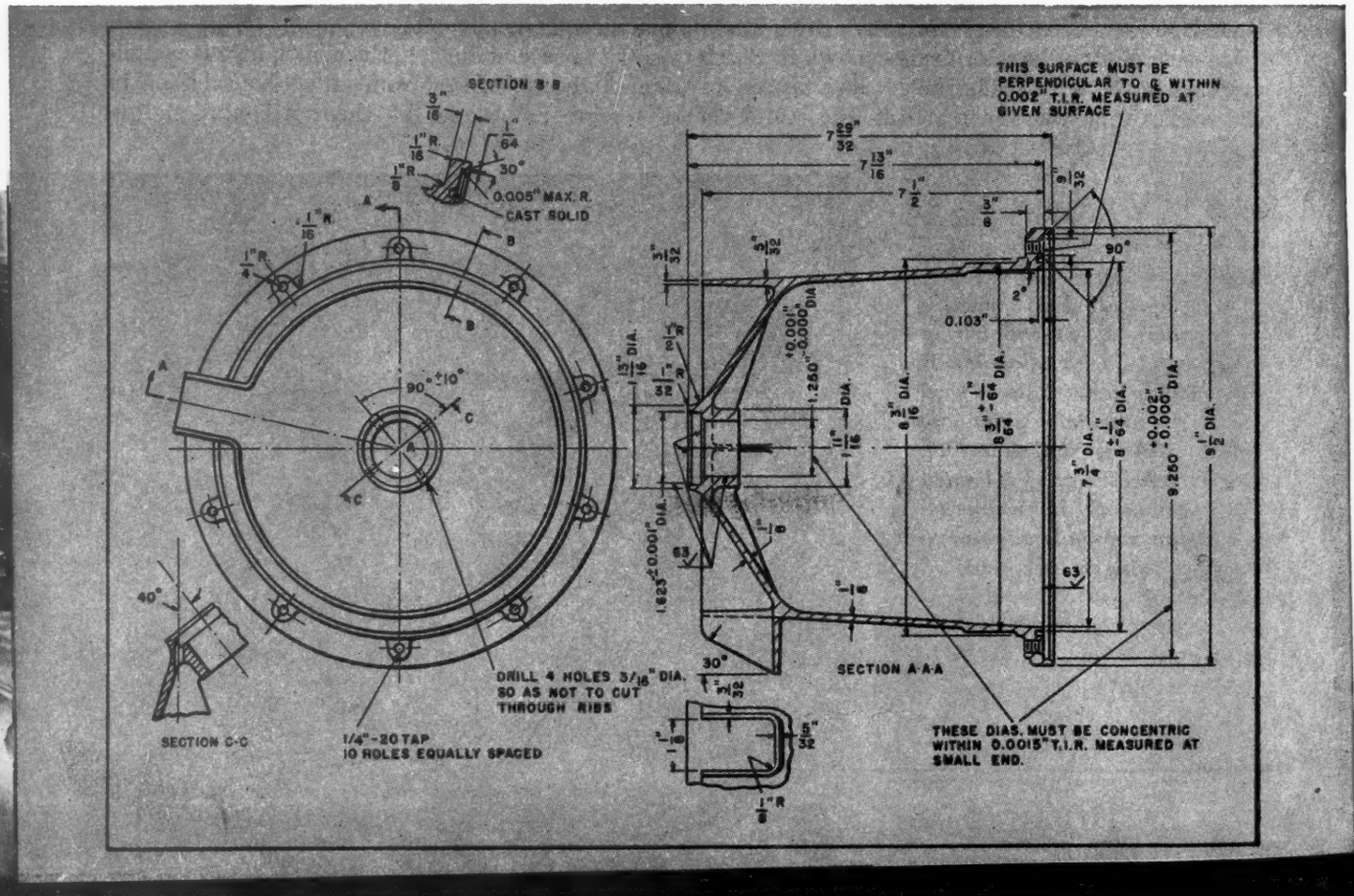

SECTION B-B
0.005" MAX. R. CAST SOLID
30°
90°±10°
40°
SECTION C-C
1/4"-20 TAP 10 HOLES EQUALLY SPACED
DRILL 4 HOLES 3/16" DIA. SO AS NOT TO CUT THROUGH RIBS
THIS SURFACE MUST BE PERPENDICULAR TO ℄ WITHIN 0.002" T.I.R. MEASURED AT GIVEN SURFACE
7 29/32"
7 13/16"
7 1/2"
0.103"
SECTION A-A-A
THESE DIAS. MUST BE CONCENTRIC WITHIN 0.0015" T.I.R. MEASURED AT SMALL END.

Fig. 15. Gear-case covers are drilled, chamfered, faced, grooved, rough-bored, and counterbored with high-speed steel and carbide tools in this five-station, horizontal, double-end machine. A gravity-feed roller conveyor is used to transfer the parts to a Heald Bore-Matic for finish-machining

Production of the balance-ring hub is also greatly expedited by the use of special hydraulic machines. This part, which is an aluminum die-casting, is processed through two such machines. The first one, illustrated in Fig. 12, is a double-end boring and facing machine having four stations.

After loading and clamping the part in a fixture mounted on an automatic, hydraulically operated, rotary indexing table, the work is indexed to the second station, where the center hole is rough-bored and the hub end turned and beveled. At the third station, the right-hand head is utilized to finish-bore the center hole to a tolerance of 0.001 inch and finish-turn the hub end within 0.002 inch tolerance. At the same time, the left-hand head is employed for facing a seat and beveling and under-cutting the flange end. Both sides of the flange are faced and a 2.473-inch diameter is turned at the fourth station. Carbide tools are used at all stations.

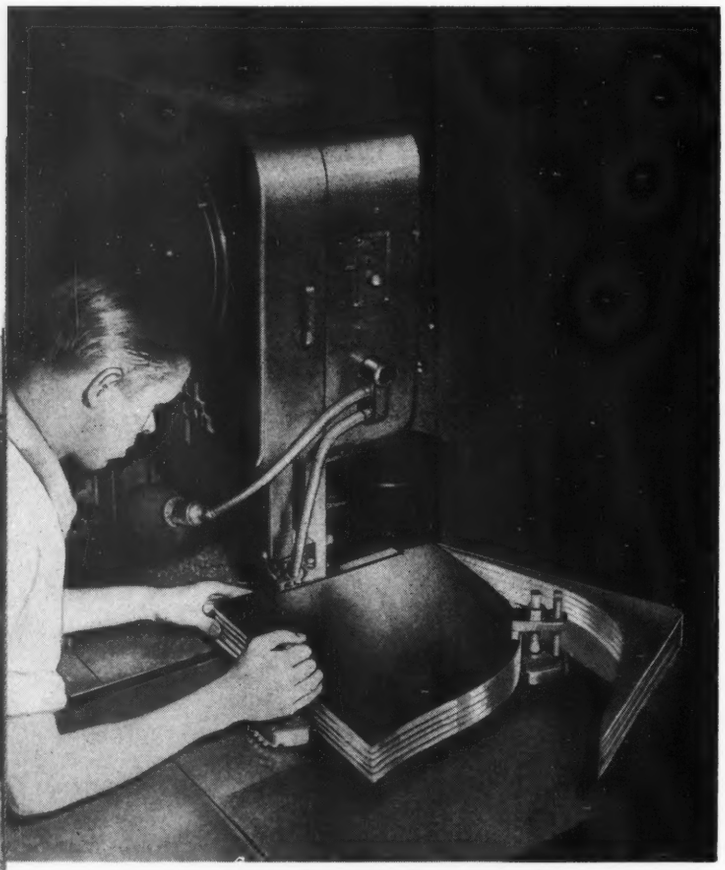
Following these operations, the balance-ring hubs are placed on a conveyor and transferred to the vertical five-station machine shown in Fig. 13. Here the work is drilled, chamfered, tapped, and milled in much the same manner as previously described. A horizontal sliding head unit is provided on this machine for drilling two through holes, 9/32 inch in diameter, in the side of the part.

Zinc die-castings from which gear-case covers (Fig. 14) are made are carried by a double-tier, gravity-feed, roller conveyor to the horizontal, double-end, five-station machine shown in Fig. 15. A continuous flow of work is achieved by processing these parts through this machine, a two-station Heald single-end Bore-Matic, a four-spindle drill press, and a special air-operated press that inserts a bushing in one end.

Fig. 16. The first station of the special machine shown in Fig. 15 is used for manually loading and unloading die-cast gear-case covers. A fully automatic, hydraulic rotary indexing table carries the work through the machining cycle

The first station of the W. F. & John Barnes Co. machine is employed for loading and unloading the work, as shown in Fig. 16. At the second station, ten holes are drilled with No. 7 (0.201-inch diameter) high-speed steel drills in the right-hand head. After chamfering these holes at the same station, the table automatically indexes to the third station, where the flange is faced and a gasket groove produced by tools in the right-hand head. At the same station, using the left-hand head, the opposite end of the part is rough-bored, counterbored, and chamfered. The right-hand head is utilized at the fourth station for producing ten 1/4-20 tapped holes in the flange. Carbide and high-speed steel tools are used at all working stations.

The conveyor then transfers the parts to the Heald machine, where the bearing seat is finish-bored and the seal recess at the bearing end is turned and faced square and concentric with the recess in the flange. Next the conveyor carries the work to the four-spindle drill press where four 3/16-inch diameter angular holes are drilled, as shown at section *C-C* and in the end view, Fig. 14. Finally, the gear-case covers are conveyed to the special air-operated press, where a bushing is pressed into the bore. The tool used for this purpose is spring-loaded to facilitate burnishing the bore of the bushing to size after installation.



* * *

Producing Small Quantities of Blanks on Contour Saws

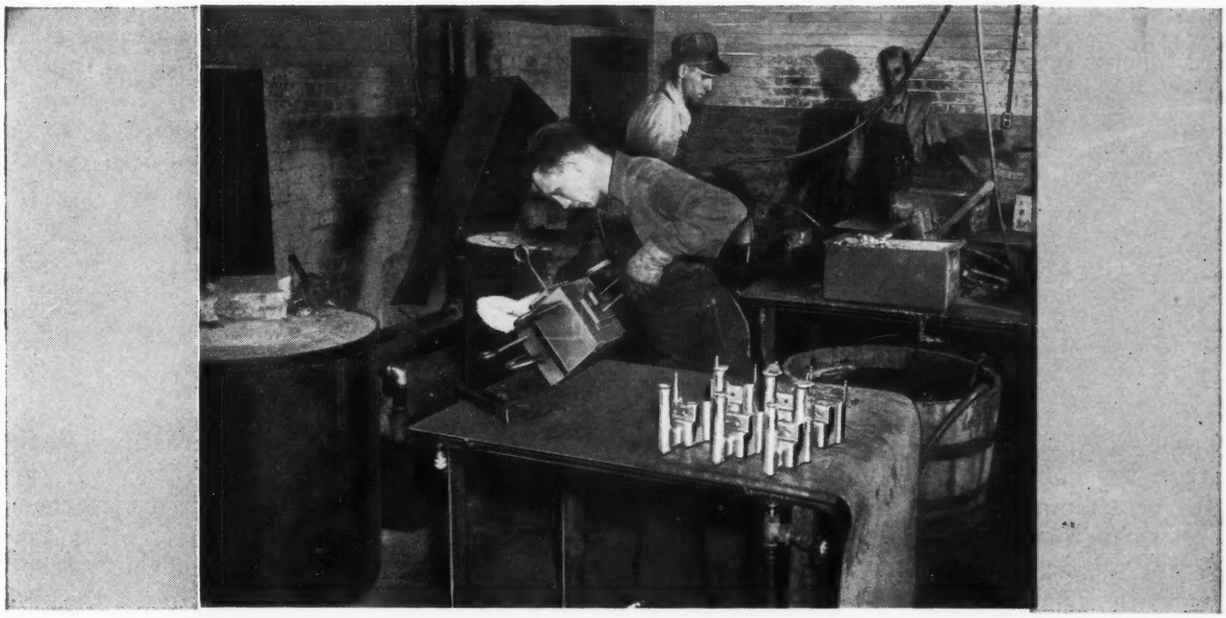
Contour saws are used to advantage for producing relatively small quantities of shaped blanks directly. For amounts of less than 500 units, stack contour sawing, as shown in the accompanying illustration, has been found to be a most economical course of procedure. No dies or other tools are required in this process, since a number of blanks are contour sawed directly from a stack of sheet stock.

The number of blanks that can be cut simultaneously from such a stack depends, of course, on the gage of the material. Although clamps can be used, it is preferable, according to the DoAll Co., Des Plaines, Ill., manufacturer of machines of this type, to press thin sheets together to eliminate air pockets and simplify bonding. While under pressure, the stock should be sweated or tack-welded at the corners and between them at four, five, or more points.

When this has been done, the top sheet is laid out by means of a templet, or with instruments, after which the stack can be sawed. With the proper saw and velocity, a cutting rate of 3/8 lineal inch per minute is easily possible on a 6-inch stack. Assuming that the outline to be sawed amounts to 60 lineal inches and that each blank is 1/32 inch thick, 192 blanks will be produced in 160 minutes, amounting to a blank production rate of 50 seconds per unit. Obviously, the design will govern the width of the saw, but the widest saw possible should be used to expedite the operation.

Blanks in quantities of less than 500 pieces are economically sawed in stacks. By laying out the contour desired on the top sheet and spot-welding or soldering the stock together at different points around the periphery, uniform blanks are produced without punches and dies

Permanent-Mold Casting of Copper-Base Alloys



By G. K. EGGLESTON and S. E. GREGORY
Non-Ferrous Permanent-Mold, Inc.
Mansfield, Ohio

CASTING of copper-base alloys in permanent molds has important advantages in certain applications. The use of this process depends upon the properties desired in the casting, the complexity of the design, the precision required, and the number of parts to be cast.

In permanent-mold casting, molten metal is poured under a gravity head into metal molds without the application of external pressure. The mold sections are assembled, and remain clamped together during pouring and solidification of the casting. It is not necessary to make a new mold for each casting, as is the case with sand castings. While the molds are not actually permanent, as the name implies, they have a long life.

Castings produced by this method are dense and fine-grained, and can be made with a better surface finish and to closer tolerances than sand castings. More liberal tolerances are required, however, than is the case with die-casting or precision casting by the "lost wax" method in plaster molds. The molds for permanent-mold casting cost less than die-casting dies, but more than dies for sand and plaster mold casting. Production rates are lower than for the same parts made by die-casting. Less metal is generally required per casting than is the case in sand casting. Porosity of permanent-mold castings is generally less than in any other form of casting.

From the foregoing, it can be seen that the permanent-mold casting process fits somewhere between sand casting and die-casting with respect to dimensional accuracy, mold or die costs, direct labor costs, production rates, and complexity of the casting. It is applicable for many parts where the ultimate in complexity of design, tolerances, or mass production need not be met.

Permanent-mold casting of copper-base alloys was not employed commercially until about 1918, when aluminum bronze began to be successfully cast by gravity in steel molds. As copper-base

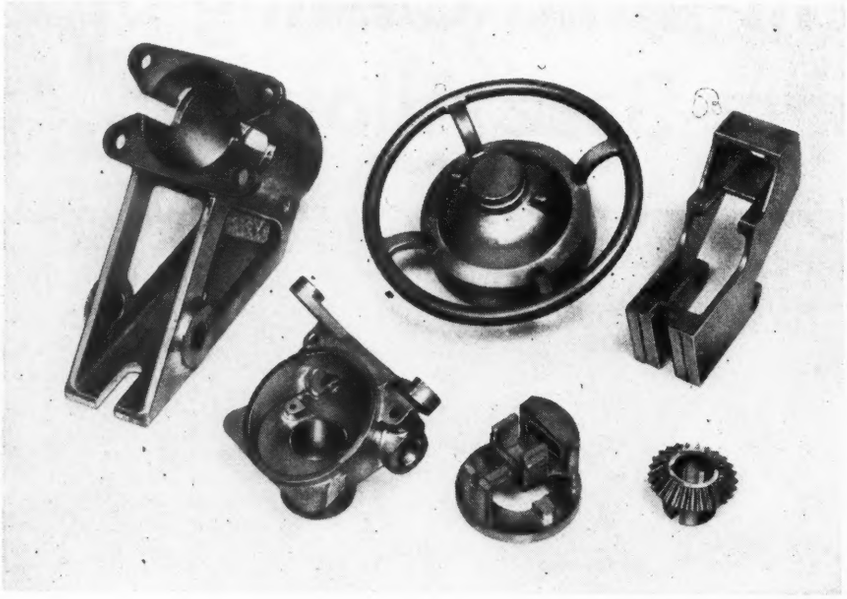


Fig. 1. A group of copper-base alloy castings produced by the permanent-mold process. Intricate parts weighing from 1/2 ounce to 25 pounds have been cast in this way

alloys have a relatively high melting point, the life of the molds is shorter than in cases where zinc or aluminum alloys are being cast. The reasons for the early success of this process in casting aluminum bronze are that this alloy is extremely fluid when molten, and the aluminum oxidizes rapidly in the molten condition, covering the surface of the metal with aluminum oxide. The film of oxide keeps the molten metal from intimate contact with the surfaces of the mold, resulting in longer die life and minimizing the possibility of the casting "freezing" to the mold.

It has been generally believed that permanent-mold casting of copper-base alloys other than aluminum bronze was impractical due to short mold life or poor physical properties of the casting resulting from residual stresses set up by shrinkage of the casting in the mold. For this reason, little development has taken place in this branch of the permanent-molding industry in this country up to the present time.

Composition and Properties of Copper-Base Alloys

	Common Name	Composition, Per Cent by Weight								
		Copper	Iron	Zinc	Manganese	Nickel	Tin	Lead	Aluminum	Impurities, Maximum
Brasses	.....	59 Min.	.....	Balance	.....	.....	.....	.....	0.5 Max.	1.0 Inc. Alum.
	Naval Brass	61 Min.	.....	Balance	.....	.....	0.5 to 1.5	0.1 Max.	0.5 Max.	0.75 Inc. Lead and Alum.
	Leaded Brass	58 Min.	.....	Balance	.....	.....	.....	1.0 Max.	.....	0.75
	Nickel Brass	55 Min.	.....	Balance	.....	4.5 to 6.0	.....	.....	0.5 Max.	0.5
	Manganese Brass	55 Min.	2.0 Max.	Balance	1.0	1.0 Max.	1.0 Max.	0.5 Max.	2.0	5.0
Bronzes	Aluminum Bronze	Balance	.....	.....	.....	.....	.....	.....	9.5 to 10.5	0.5
	.....	Balance	3.0 to 6.0	.....	2.5 Max.	3.0 to 6.0	.....	.....	8.0 to 12.0	0.3
	.....	Balance	1.5 to 3.5	.....	3.5 Max.	4.0 Max.	.....	.....	7.5 to 10.5	0.3
	.....	Balance	1.0 to 1.5	.....	.....	.....	.....	.....	10.0 Max.	0.5
	Bell Metal	Balance	.....	.....	.....	.....	17.0 to 19.0	.....	0.4 to 0.6	0.5
	.....	Balance	1.0 to 1.5	.....	.....	.....	1.3 to 1.8	.....	8.5 to 9.5	0.2

Fig. 2. Mold members are held together by means of C-clamps while the molten metal, which is transferred from the furnace by ladle, is poured. Rate of pouring must be carefully controlled

In England, however, the art of permanent-mold casting has been developed to a much greater extent. By proper mold design and the generation of synthetic films to protect the mold surfaces and permit easy removal of the casting, many sound, dimensionally accurate castings are now being produced from 60-40 brass, manganese bronzes, tin bronzes, and other copper-base alloys, as well as aluminum bronzes. The tonnage of permanent-mold castings has increased to over twenty-five times the late 1920 figures, and today over 60,000 tons of copper-base alloys are cast in permanent molds each year, compared to only 500 tons in the United States.

There are three industries that buy approximately 80 per cent by weight of all the permanent-mold castings made from copper-base alloys in England; these are electrical products, transportation equipment, and the plumbing fixture industries.

Importing "know-how" from the casting art developed by the English, Non-Ferrous Permanent-Mold, Inc.—a new company jointly owned by the Barnes Manufacturing Co., Mansfield, Ohio, and the Non-Ferrous Die Casting Co., Ltd., London, England—has begun to manufacture copper-base alloy castings by the permanent-mold process on a pilot-line basis.

Special alloys, listed in the accompanying table, have been developed to give various degrees of mechanical strength, corrosion resistance, electrical conductivity, bearing properties, surface appearance, etc., in the permanent-mold castings. In general, copper-zinc and copper-zinc-manganese alloys containing more than 65 per cent copper cannot be cast economically in permanent molds. Alloys are compounded from virgin metals, with the composition percentages closely controlled. If the composition of the alloy

for Permanent-Mold Casting

Melting Point, Degrees F.	Casting Range, Degrees F.	Yield Strength, Pounds per Sq. In., 0.1 Per Cent Elongation	Ultimate Tensile Strength, Pounds per Sq. In.	Elongation, Per Cent In 2 Inches	Brinell Hardness (500-Kg. Load, 10-Mm. Ball)
1706	1796 to 1868	10,080	40,320	25	70 to 75
1706	1796 to 1868	11,200	44,800	20	75 to 80
1688	1796 to 1868	11,200	49,280	15	65 to 70
1742	1832 to 1922	11,200	49,280	25	90 to 95
1742	1832 to 1922	33,600	76,160	15	90 to 110
1904	1976 to 2048	17,920	62,720	20	85 to 95
1922	1994 to 2084	40,320	89,600	12	180 to 200
1904	1976 to 2048	22,400	71,680	20	90 to 110
1904	1976 to 2048	22,400	69,440	12	90 to 100
1850	1904 to 1976	20,160	33,600	2	90 to 100
1904	1976 to 2048	22,400	60,480	7	140 to 160

varies or too many impurities are present, a satisfactory casting cannot be produced.

Castings of considerable intricacy, weighing from 1/2 ounce to 25 pounds each, have been successfully produced. Although permanent-mold castings do not have the highly finished appearance of die-cast parts, they are clean and bright, and have smooth surfaces and well defined corners. A few of the many parts cast in this way are shown in Fig. 1.

In general, tolerances can be maintained within ± 0.010 inch on dimensions up to 1 inch, and within ± 0.005 inch per inch above 1 inch. Cored holes are generally held to ± 0.005 inch, but closer tolerances can sometimes be maintained. A minimum wall thickness of 3/32 inch should be provided in permanent-mold castings, and a thickness of at least 1/8 inch is preferable. Core diameters should not be less than 1/8 inch in most cases, and 3/16 inch is preferred.

A major advantage of permanent-mold castings is that little or no machining is required. When subsequent polishing or plating is necessary, the finishing costs are considerably less than with sand castings. In addition to smoother surface finish, higher hardness and a superior grain structure than in comparable sand castings are obtained. About 500 is considered the minimum number of parts that can be economically cast in permanent molds. There is no limit to the maximum quantity that can be cast by this process, provided the part is adaptable.

Either electric or fuel (gas or oil) heated furnaces can be used for melting copper-base alloys that are to be cast in permanent molds. The selection is generally governed by the cost of electricity or fuel at the site of the foundry. Direct contact between metal and fuel should be avoided.

The melting points and casting temperature ranges for the various alloys are given in the accompanying table. The exact pouring temperature to be employed depends upon the size and shape of the casting, its section thickness, and the alloy being cast. Best results are obtained by pouring at the lowest possible temperature, since high temperatures lower the solidification rate and may cause hot shrinkage, tears, cracks, or porosity. In general, however, higher temperatures in the casting range are required for intricate-shaped castings.

Permanent molds are made from a special heat-resistant steel. Life of the mold varies with the design of the casting, but averages about 125,000 for castings weighing from 1/2 ounce to 1 1/2 pounds, and about 65,000 for larger castings. No set rules can be established for the design of permanent molds, since the size, shape, and location of gates and runners will vary with the alloy and the intricacy of the casting.

Runners must be of ample dimensions in order to feed the cavity adequately and compensate for shrinkage. It is necessary to so locate the cores, light and heavy sections of the casting, gates, runners, and risers that controlled directional solidification is obtained. For internal coring, it is usually necessary to provide a taper of 0.005 inch per inch.

Built-up or sectional mold construction is employed whenever possible to minimize the original and maintenance costs by facilitating machining and permitting replacement of components. For example, a double-impression mold for casting battery terminals two at a time is made up of eighteen separate parts. Such a

Fig. 3. When the molten alloy has solidified, the cores are withdrawn, the mold is opened, and the casting is removed. A large runner is necessary to compensate for shrinkage

Fig. 4. A graphite-base water paint is applied to the casting surfaces to prevent oxidation, cracking, or scoring and to keep the casting from adhering to the mold

design also promotes adequate venting, and the relatively light weight of the parts permits easy handling, assembly, and dismantling. All the parts of the mold do not have to be separable, and some are occasionally joined to form permanent sub-assemblies.

Mold parts are generally aligned at assembly by means of dowels and reamed holes, while cores and inserts fit into recesses provided in the mold. Radial location can be obtained by providing the cores with pins which engage grooves machined in the mold recesses. The outer ends of the cores are flanged to facilitate disassembly after casting. A flat iron bar is inserted between the flange and the body of the mold to start withdrawal of the core. Handles are provided on the mold members to permit easy manipulation. Ejector-pins are employed in some molds, such as those operated on semi-automatic machines.

Hand-polishing of the casting surfaces in the mold cavity is not required, since the mold paint, applied prior to casting, fills in any minute irregularities on the surfaces. Also, due to the low pressures inherent in gravity casting, the molten metal is not forced into fine cracks or surface irregularities in the mold cavity. The operating temperature of the mold face should closely approximate the pouring temperature of the casting alloy. The molds are preheated by means of a gas flame for about one-half hour before starting production. A suitable mold temperature is maintained during production by heat from the casting alloy.

Mold members are held together during casting by C-clamps or mechanical means in the simplest types of machines. In hand-operated machines, cams are employed to move and hold the mold parts together. For greater production, semi-automatic machines can be employed in which air or hydraulic clamping is utilized, but because of the solidification rate of copper-base alloys, machines of this type are not generally necessary.

Casting is performed on metal-top benches adjacent to the melting furnaces, the molten metal being transferred from furnace to mold by a ladle, as shown in Fig. 2. Best results are sometimes obtained by tilting the mold before pouring, as shown, depending upon the design of the casting, and gradually returning the mold to the horizontal position as pouring proceeds.

A comparatively slow pouring rate is necessary in filling the mold because of the low pressure exerted by gravity casting. Thus trapped air has a chance to escape from the mold and sound castings result. Pouring rates, however, vary with every job, and no strict rule can be given. When the molten alloy begins to solidify, which is only a matter of seconds, because such alloys have a rapid freezing cycle, the cores are withdrawn, the mold is opened, and the casting is removed, as seen in Fig. 3.

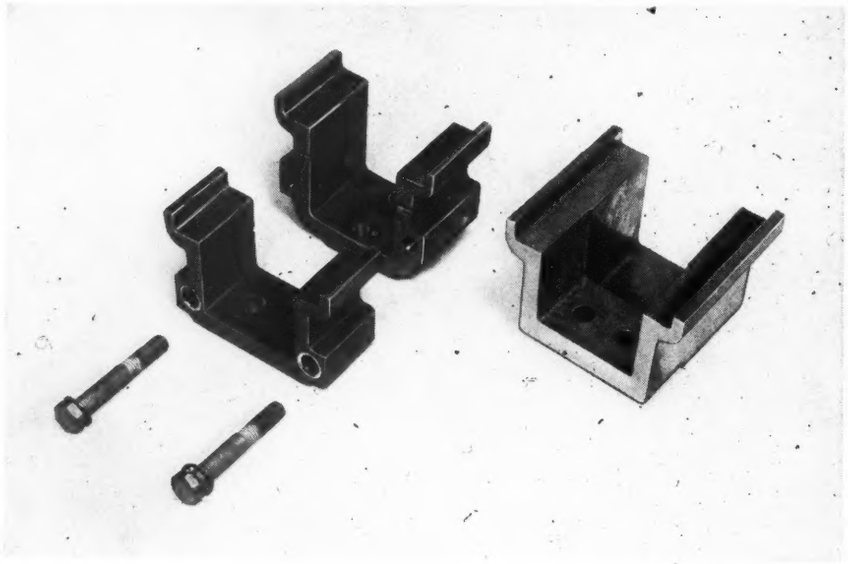


Fig. 5. Connector bracket for electrical control equipment, seen at right, is cast from SAE 43 manganese bronze in the permanent molds illustrated in Figs. 2 to 4. Part was previously made from two extrusions, as shown at the left

Prior to casting and before reassembling the mold during production, the casting surfaces of the mold, gates, runners, risers, and cores are coated with a special graphite-base water paint. This is done to prevent oxidation, heat-checking, erosion, and scoring of the casting surfaces of the mold, and to minimize "freezing" of the casting to the mold.

The mold blocks do not reach as high a temperature as the cores, because of the greater mass exposed to the atmosphere, and the paint can therefore be sprayed on the casting surfaces, as in Fig. 4. The hotter, lighter cores, however, are hand-dipped into a container of paint to cool as well as coat them. A sufficiently large container is employed to prevent overheating of the paint, and the paint is constantly agitated by the action of compressed air.

The permanent-mold casting produced in the mold seen in Figs. 2 to 4, inclusive, is shown at the right in Fig. 5. This S A E 43 manganese-bronze connector bracket for electrical control equipment used on Diesel locomotives weighs 4 pounds, measures about 3 1/2 inches cube, and has wall thicknesses from 1/4 to 1/2 inch. The part was previously made from two different extruded shapes, sawed to the required lengths, drilled, and screwed together, as shown at the left. In the one-piece design, drilling of two of the six holes has been eliminated by coring, and a 50 per cent saving in the cost of production per part has been obtained.

Battery terminals are cast two at a time in a permanent mold. The permanent-mold castings are made from a 60-40 brass, while sand castings of a similar type part are produced from a cheaper grade of the same alloy, with a higher percentage of impurities. Casting costs, including prices of the alloys, are practically the same for both processes, but fewer terminals are rejected with permanent molds. Also, post holes must be reamed and cross-holes drilled in the sand castings to insure alignment, while no drilling or reaming is necessary on the permanent-mold castings.

Permanent-mold castings can be made with a wide variety of inserts, cast in place. Some provision must, of course, be made in the mold for locating and holding the insert. One or more sand cores are sometimes used in conjunction with the permanent mold to produce intricate castings. Such parts are referred to as "semi-permanent mold" castings. Teeth can be cast close to size; however, gears cast in permanent molds are recommended only for light-duty applications, and not for power-driven operation.

Collective Bargaining on a Sound Basis

FARSIGHTED business men realize that collective bargaining is an inevitable result of the expansion of industrial enterprises to the point where the individual workman has little opportunity to barter for the highest remuneration for his services. Actually, collective bargaining is probably the best way of handling industrial relations. Difficulties in this method of resolving disputes have resulted mainly from inability of labor and management to conduct negotiations in an atmosphere of mutual respect or with an understanding of the fundamental principles on which sound collective bargaining must be based.

Principles that provide a foundation for constructive collective bargaining were outlined in an address delivered at the spring meeting of the National Machine Tool Builders' Association by W. Walter Williams, chairman of the board of trustees of the Committee for Economic Development. These principles are:

1. Labor and management must believe in capitalism, and help to make it work.

2. Labor and management must believe in ever increasing productivity, and must work to achieve it.

3. Labor and management must believe in the managerial function.

4. Labor and management must make decisions on the basis of economic fact, not economic power.

5. Labor and management must accept primary responsibility to the community.

That capitalism is the preferable economic system for a democratic nation if our high standards of living are to be maintained must be the belief of both labor and management. These standards are the result of the progressiveness of our industrial leaders and the productivity of American workmen down through the years. The "isms" of Europe would soon lower the plane of our national welfare.

Labor and management must constantly strive for increased productivity, so that more goods will be available to more people at prices they are able to pay. On this basis only can industrial plants maintain high levels of employment.

There must always be leaders in any enterprise to direct intelligently the large body of co-workers. For this reason, the managerial function must be respected by labor. At the same time, management should rely extensively on the experience and counsel that a friendly labor organization can provide.

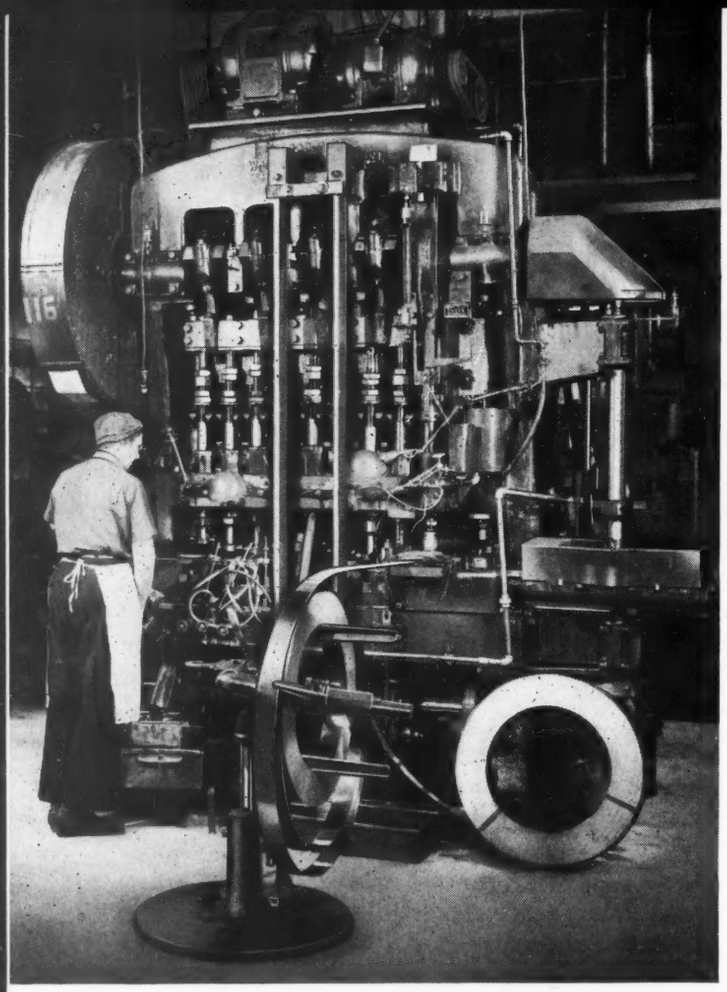
The main reason for the costly disputes between labor and management is the fact that decisions are too frequently made on the basis of economic power instead of economic facts. Unions take advantage of their large membership to close down entire industries—sometimes even companies who are willing to meet the union demands. They take unfair advantage of economic power. On the other hand, business men are loath to disclose profit sheets which would enable negotiations to be conducted on an understanding basis. However, labor leaders want to see financial statements only when profits are high, and not when profits are low or nonexistent.

The last principle expounded by Mr. Williams is perhaps the most important. Unless labor and management recognize their responsibilities to the community, markets will disappear, with the result that both workers and investors will suffer. The anthracite coal industry is a case in point; the frequent disputes in that industry led to the adoption of oil heating systems to such an extent that the use of anthracite coal has been greatly curtailed. Mines have been closed down and short labor weeks suffice to supply the normal demand for hard coal.

Collective bargaining is here to stay—labor and management should strive to establish it on a sound economic basis!

Charles O. Herb

EDITOR



Deep-Drawing of

Technique Employed by the Advance Stamping Co. in Drawing Deep, Small-Diameter Cups from Thin Stainless-Steel Strip Stock on Transfer Type Presses. As Many as Eight Progressive Draws are Made without Intermediate Annealing

By CHARLES H. WICK

STAINLESS steels—especially the austenitic chromium-nickel alloys—are well suited to deep-drawing operations because of their high ductility and low yield strength. Such alloy steels, however, have a relatively high tensile strength and tend to strain-harden during cold-working. Strain-hardening results in a high resistance to final forming. For these reasons, it is necessary to exercise care and employ special techniques in deep-drawing stainless steel.

Although stainless-steel parts generally require annealing between deep-drawing operations to relieve the stresses set up by cold-working, it is possible to form small parts progressively by rapidly moving the part between multiple dies on a transfer type press. In this way, the need for cleaning and annealing of the parts between drawing operations is eliminated, the cost of the product is reduced, handling is minimized, and production increased.

The stainless steels preferred for deep-drawing are the AISI Types 302, 304, and 305 austenitic 18-8 chromium-nickel alloys. Type 305 is the most desirable grade for extra deep drawing. Although the straight, high-chromium stainless-steel alloys have a lower ductility and tend to become brittle at elevated temperatures, they can be drawn satisfactorily. Considerable success has been obtained in deep-drawing the Type 430 alloy in the latter group. With the proper chemical composition, this stainless steel has less tendency to strain-harden.

Cold-rolled and annealed stock is preferred because it can be stretched further and there is less tendency for the metal to wrinkle when it is in this condition. A pickled surface on the strip stock is also desirable, since such a rough surface has better lubricant retaining qualities. With stainless steel, because of its high strength, reductions of blanks can be from 1 to 2 per cent greater than with other metals. Even in the annealed condition, however, stainless steels require from 50 to 100 per cent higher hold-down and forming pressures than low-carbon steels.

In addition to having the required power, the presses employed for deep-drawing of stainless steel must be rigid and maintained in good condition. A relatively slow forming speed of about 40 feet per minute is generally necessary to minimize heating, decrease the rate of work-hardening, and avoid seizing or pick-up on the tools. Sufficient hold-down pressures are essential to prevent puckering. If a wrinkle-free cup is produced in the first operation, most of the forming troubles are eliminated. Once formed, wrinkles will persist throughout the subsequent drawing operations, and are difficult to remove.

Automatic multiple-die, transfer type presses, made by the Waterbury Farrel Foundry & Machine Co., are employed by the Advance Stamp-

Stainless Steel on Transfer Type Presses

ing Co. for deep-drawing of stainless-steel parts from thin strip stock. As seen in the heading illustration, the strip stock is fed automatically from a coil (mounted on a reel in front of the press) between the blanking punch and die. The scrap stock is wound on a reel at the rear of the press. The blank, produced at the first station —seen at the right in Fig. 1—is pushed down through the die into a transfer slide, which automatically moves to the left when the blanking punch moves upward, thus carrying the blank to the second or cupping station.

A cam-actuated blank-holder is provided at the cupping station to hold the blank flat while the cup is being drawn. During this operation, the transfer slide is automatically shifted back to the right to pick up another blank. On the up stroke of the cupping punch, a knock-out pin ejects the cup from the die. A pair of spring-actuated fingers is attached to the slide at this and successive stations to grip the work while it is being transferred. When the slide is again moved to the left, the cup is carried to the third or redrawing station and the second blank is transferred to the cupping station. As the cycle is repeated, the part is transferred successively to the remaining stations. Thus a part is completed at each stroke of the press, being ejected from the final die into a delivery tube leading to a tote box.

A vertical shaft on the right-hand side of the press, driven by bevel gears from the upper camshaft, carries a cam which, through adjustable roll followers, reciprocates a dovetailed slide to which the transfer slide is connected. A lower knock-out shaft, driven from the vertical shaft by bevel gears, carries the blank-holder cam and a series of knock-up cams for lifting the cups from the dies. On cam type presses, the vertical acting plungers that carry the blanking and drawing punches are actuated individually by a series of push-down and lifter cams mounted on the upper camshaft. On crank presses, such as shown in the heading illustration, the plungers are operated by the crankshaft. Nine plungers are provided on the machine shown, but other presses contain seven or eleven.

Cemented-carbide dies are employed for cupping and subsequent drawing operations, while a water-hardening, high-carbon tool steel is used for the blanking die and drawing punches. It has been found that carbide dies have a longer life; in some cases as many as 100,000 parts can be drawn with one die between sharpenings. Also, a better surface finish is produced on the drawn part, less scrap results, and very little pick-up or galling is encountered because of the non-seizing properties of carbide.

The dies are produced by diamond boring and lapping the rough-cored, round carbide nib, which has been pressed into an SAE 6145 alloy steel case. The forming surface of the die is polished to as smooth a finish as possible to minimize pick-up and scoring of the metal.

For blanking, the clearance between punch and die is standard, varying with the thickness of the material. Sharp tools are essential, because a cold-worked edge on the blank would in-

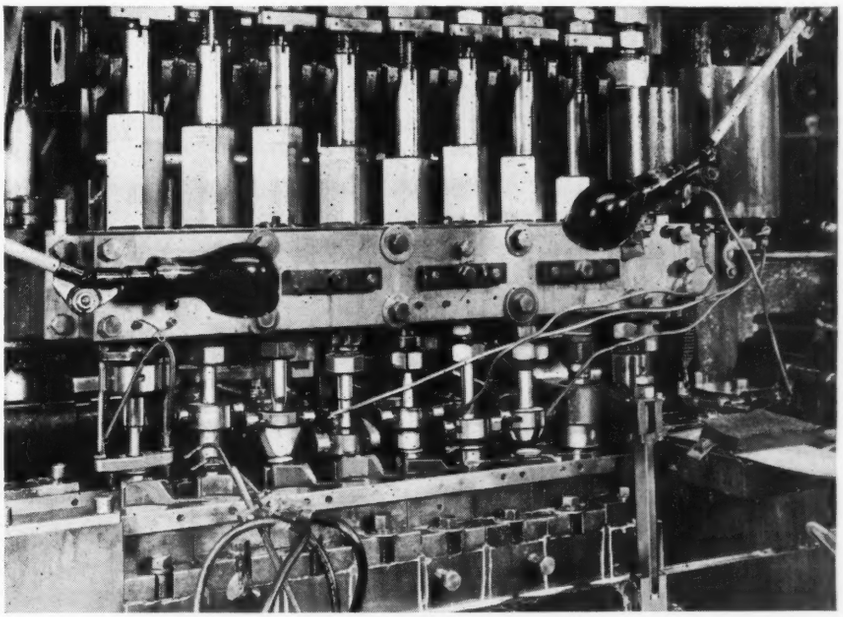


Fig. 1. Close-up view of the tooling area on an automatic multiple-die transfer type press of the type seen in the heading illustration

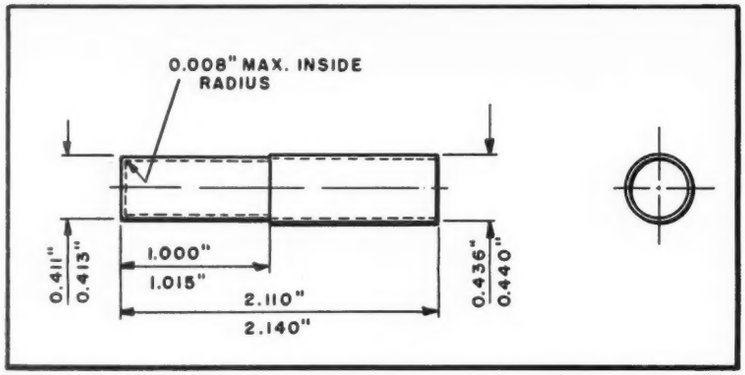


Fig. 2. Generator head, deep-drawn from 0.010 inch thick by 2 5/32 inches wide stainless-steel strip stock on a nine-station press

crease the possibility of stress-cracking during subsequent forming. Clearance between punch and die in cupping and subsequent drawing operations depends upon the design of the part. Ironing is not common in deep-drawing operations, and it should be avoided whenever possible because of the severity of the operation on both material and tools. However, ironing is specified on certain parts in order to reduce the wall thickness. In such cases, of course, the clearance per side between punch and die must be less than the thickness of the metal being worked. For redrawing thin metal, a clearance equal to the metal thickness plus 15 per cent is usually allowed. Too much clearance will cause the metal to buckle or pucker.

Rounded corners at the entry of the cupping or drawing dies should have a radius equal to about six times the material thickness. Larger radii will increase the possibility of wrinkling, while radii smaller than four times the metal thickness will increase the rate of work-hardening. Such small radii, however, are sometimes necessary to prevent wrinkling when thin metal is being redrawn.

Punch radii should be equal to at least four times the metal thickness. Smaller radii, although sometimes necessary because of the product design, may cause failure by tearing at the corner of the cup. Punches having radii larger than four times the metal thickness generally require a greater hold-down pressure to avoid puckering.

As previously mentioned, the amount of pressure exerted on the edge of the blank during cupping is a critical factor. The hold-down pressure must be distributed uniformly around and near the edge of the blank to obtain a centralized cup, and must be sufficient to prevent wrinkling. Excessive hold-down pressures will increase the rate of work-hardening and may cause tearing. If wrinkles do form, they are difficult to remove unless they are shallow.

Lubricant is applied to the strip stock by passing the strip through a sponge box located in front of the blanking station. It is fed to the cup and subsequent drawn shapes by means of tubes leading to each station, Fig. 1. An efficient, heavy-duty lubricant is necessary in deep-drawing stainless steel to reduce scrap and obtain maximum tool life. Since the drawn parts must be cleaned prior to annealing, the ease with which the lubricant can be removed is an important factor to be considered in selecting a lubricant for parts requiring annealing. A water-base lubricant is desirable because the parts can be cleaned easily. For severe drawing, however, a pigment type drawing lubricant containing fatty oils diluted in mineral oil is generally necessary.

While a 50 per cent reduction in diameter can be obtained in a single operation when deep-drawing stainless steel under suitable conditions, the reduction during cupping in progressive drawing is generally restricted to 40 per cent. In other words, the diameter of the cupping punch

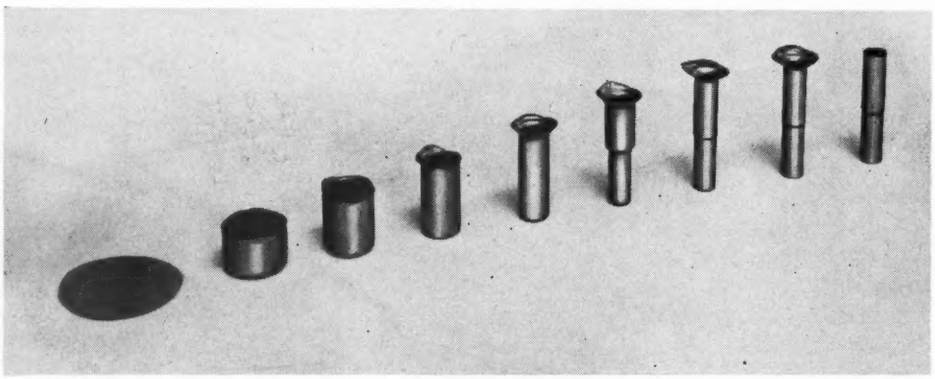


Fig. 3. Successive steps in the production of the generator head shown in Fig. 2 on a multiple-die transfer press

is made 60 per cent of the blank diameter for the first operation. By limiting the reduction to 40 per cent in the initial draw, the resulting cup has a more uniform wall thickness, with relatively higher strength, and greater reductions can be made in subsequent draws. In each subsequent draw, the diameter of the part can be reduced from 20 to 25 per cent. The final reduction is generally from 15 to 20 per cent.

The exact per cent of reduction in diameter specified for each operation will vary with the thickness and type of material being drawn, the diameter of the blank, the number of draws required, and the design of the part. It is best to have as few operations as possible, since a large number of small reductions will increase the rate of work-hardening and cause failure.

A total reduction of almost 80 per cent is obtained in producing the generator head seen in Fig. 2. The part is produced from Carpenter Steel Co. No. 3 stainless (AISI Type 443) strip stock, 0.010 inch thick by 2 5/32 inches wide, on a nine-station, transfer type press. The blank, 2 inches in diameter, produced at the first station, is shown at the left in Fig. 3. The first drawn piece, or cup, is seen to the right of the blank, and the next five parts are successive reductions made from the third to seventh station, inclusive.

At the eighth station, the finish-drawn part is sized to length. The part is pinch-trimmed at the ninth and final station by being pushed down through the die. A completed generator head is seen at the right. This part is rather difficult to produce because the small-diameter end must be maintained within $\pm$ 0.001 inch of the desired size, and a sharp corner (0.008 inch maximum radius) is specified for the bottom inside corner.

Tiny retainer caps, Fig. 4, for electrical couple controls are produced at the rate of 3000 per hour on an eight-station transfer type press. Carpenter stainless steel No. 6 (AISI Type 430), 0.0085 inch thick by 15/16 inch wide, is employed for this operation. Two rows of blanks, each blank 0.458 inch in diameter, are obtained from each coil of strip stock by feeding the coil through the press twice.

The successive steps in the production of the part are shown from left to right in Fig. 5. Only four reductions are made after cupping. At the seventh station, the part is sized to length, and the flange is formed. The flange is pinch-trimmed at the eighth station. The total reduction in diameter in this operation is 75 per cent.

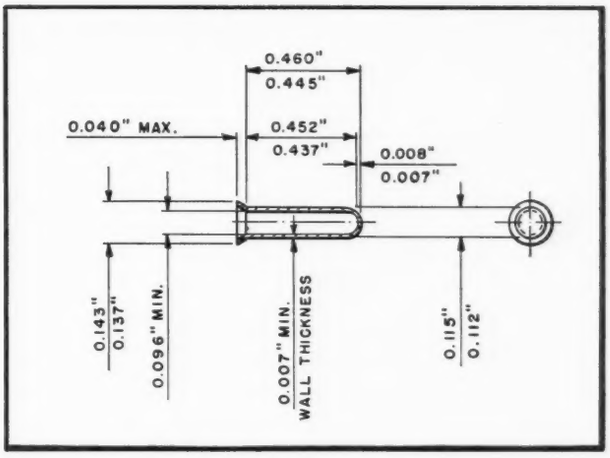


Fig. 4. Retainer caps for electrical couple controls, such as shown, are deep-drawn at the rate of 3000 per hour from stainless steel 0.0085 inch thick

* * *

Copper-Brazed Cams

A low-cost method of producing cams is announced by Technical Metal Processing, Inc., E. 55th St. at Lake Court, Cleveland 14, Ohio. By this method, the cams are made from stamped steel laminations, which are stacked together and copper-brazed into a single unit. Such cams are said to be approximately equal in strength to those made from solid steel, have a high degree of accuracy, and can be heat-treated by conventional methods. The company offers a complete engineering and designing service to industry.

* * *

An intensive course in quality control by statistical methods will be given by the College of Engineering, University of Colorado, August 14 to 25. This course is open to production and management personnel throughout the country. Further information regarding tuition and other details can be obtained by writing Dean C. L. Eckel, University of Colorado, Boulder, Colo.

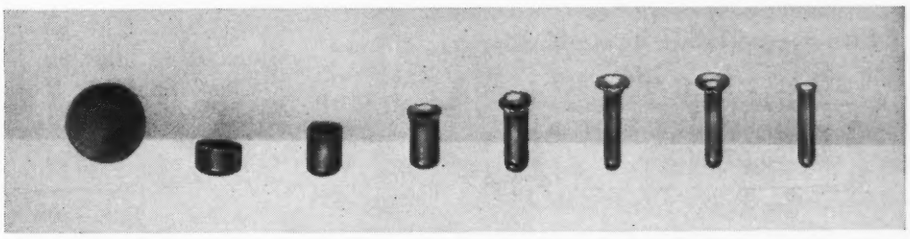


Fig. 5. Blanking, cupping, redrawing, squaring, and trimming operations are performed in producing the cap seen in Fig. 4

Selection and Design of

Second of a Series of Articles Presenting Methods and Formulas Employed in Designing and Selecting Shaving Cutters for Gears. This Article Describes a Step-by-Step Procedure for Designing a Gear-Shaving Cutter

IN the first installment of this article, published in May MACHINERY, page 164, formulas were given for selecting or designing a rotary helical gear-shaving cutter and the calculation procedure was outlined. In this article, an example will be given of the steps to be taken in designing a shaving cutter for a helical pinion, following the calculation procedure given.

Designing Shaving Cutter for Helical Pinion

As an example of the application of Equations (1) to (15), given in the first installment of this article, a shaving cutter will be designed for a helical pinion. The data for the pinion and its mating gear are as follows:

	Pinion	Mating Gear
Number of teeth	24	240
Diametral pitch	16	16
Pitch diameter, inches	1.500	15.00
Outside diameter, inches	1.625	15.125
Addendum, inches	0.0625	.....
Whole depth, inches	0.150	.....
Helix angle, degrees	23	.....
Circular pitch, inches	0.196349	.....
Normal circular pitch, inches	0.180740	.....
Pressure angle, degrees	20	.....
Normal pressure angle	18°31′21.6″	.....
Normal tooth thickness, inches	0.0870	.....

Step 1—Calculating Maximum and Minimum Shaving Diameters of Pinion

Assume that the pinion is hobbed with a preshave hob having a normal circular pitch and a normal pressure angle corresponding to that of the pinion and having a given distance from the hob pitch line to the protuberance high point. First, the under-cut diameter D_u of the pinion may be calculated from Equations (10), (11), and (12), substituting D_u for D. According to the given data, $\phi_p = 20$ degrees; $D_p = 1.5$ inches; and $h = -0.071807$ inch. Then:

$$Y = -0.071807 + \frac{1.500}{2} = 0.678193 \text{ inch} \quad (10)$$

$$X = \frac{-0.071807}{0.363970} = -0.197288 \text{ inch} \quad (12)$$

$$\left(\frac{D_u}{2}\right)^2 = (-0.197288)^2 + (0.678193)^2 \quad (11)$$

Then

$D_u = 1.412612$ inches for pinion

Next, the contact diameter D_c of the pinion is found by applying first Equation (13) to find X, using the gear data, and then Equation (12) to find h for the gear. The h dimension is then transferred to the pinion by reversing its sign. Equations (10), (11), and (12) are then applied to the pinion substituting D_c for D. According to the given data, D (gear) = 15.125 inches; D_p (gear) = 15 inches; D_p (pinion) = 1.5 inches; and $\phi_p = 20$ degrees.

Then

$$X = \frac{\sqrt{15.125^2\,(1 + 0.363970^2) - 15^2} - (15 \times 0.363970)}{2\,(1 + 0.363970^2)} \quad (13)$$

$X = 0.166670$ inch for gear

$h = 0.166670 \times 0.363970 = 0.060663$ inch for gear (12)

and

$h = -0.060663$ inch for pinion

$$Y = -0.060663 + \frac{1.5}{2} = 0.689338 \text{ inch for pinion} \quad (10)$$

$$X = \frac{-0.060663}{0.363970} = -0.166670 \text{ inch for pinion} \quad (12)$$

$$\left(\frac{D_c}{2}\right)^2 = (-0.166670)^2 + (0.689338)^2 \quad (11)$$

$D_c = 1.418401$ inches for pinion

An excess form allowance of 0.004 inch is subtracted from D_c to give a form diameter for the pinion of $D_f = 1.414401$ inches. The amount of excess form allowance is based on experience and the class of gearing.

The transverse tooth thickness t of the pinion is now found by using Equation (5):

$$t = \frac{0.0870}{0.920505} = 0.094513 \text{ inch} \quad (5)$$

Gear-Generating Tools

By W. H. BOOKMILLER
Gear Generating Division
General Electric Co.

The second step in the calculation procedure is to determine the number of teeth, pitch diameter, and helix angle of the shaving cutter.

The helix angle ψ of the shaving cutter is found by assuming a crossed-axis angle of 10 degrees and subtracting it from the pinion helix angle. The cutter helix angle is thus equal to 13 degrees. The crossed-axis angle is based on experience, values of 8 to 10 degrees having usually been found satisfactory.

The center distance limitations of the shaving machine and other factors indicate that the preferred pitch diameter of the shaving cutter is approximately 9 inches.

The number of cutter teeth for a normal circular pitch of 0.1807 inch, a helix angle of 13 degrees, and a pitch diameter of 9 inches is 152. Actually 157 is selected as the largest prime number that will result in a pitch diameter close to 9 inches.

The normal circular pitch p_n and normal pressure angle ϕ_n of the cutter are equal to those of the pinion. Since a helix angle ψ and number of teeth N have been assumed, the transverse circular pitch p_t, pressure angle ϕ_t, and pitch diameter d_p are readily found from Equations (1), (2), and (4). The axial pitch p_x will be needed later and is found from Equation (3). According to the given data, $p_n = 0.180740$ inch; $\psi = 13$ degrees; $N = 157$ teeth; and $\phi_n = 18$ degrees 31 minutes 21.6 seconds.

$$p_t = \frac{0.180740}{0.974370} = 0.185494 \text{ inch for cutter} \quad (2)$$

Substituting cutter pitch diameter d_p for D in Equation (1),

$$d_p = \frac{157 \times 0.185494}{3.141593} = 9.269997 \text{ inches for cutter} \quad (1)$$

$$p_x = \frac{0.180740}{0.224951} = 0.803463 \text{ inch for cutter} \quad (3)$$

$$\text{Tan } \phi_t = \frac{0.335036}{0.974370} = 0.343848 \quad (4)$$

$\phi_t = 18$ deg. 58 min. 31.6 sec. for cutter

The cutter data may be summarized as follows: Number of teeth, 157; pitch diameter, 9.269997 inches; normal circular pitch, 0.180740 inch; circular pitch, 0.185494 inch; axial pitch, 0.803463 inch; normal pressure angle, 18 degrees 31 minutes 21.6 seconds; pressure angle, 18 degrees 58 minutes 31.6 seconds, and helix angle, 13 degrees.

The third step in the procedure is to calculate the shaving cutter and pinion tooth thicknesses, helix angles, and pressure angles at various rolling pitch diameters.

A series of rolling pressure angles ϕ_1 is assumed for the pinion. The range of angles ϕ_1 must be sufficient to give a suitable range of cutter tooth thickness. Since many variables enter into determining the correct range, it is easier to assume several values that will more than cover the required tooth thickness range and plot a curve of the calculations. The most desirable section of the curve can then be selected. The values of ϕ_1 that will be assumed for the pinion are 20, 19, and 18 degrees.

The following calculations, shown to illustrate the specific procedure, will be based upon a value of 19 degrees for ϕ_1. Calculations based on the other values of ϕ_1 are, of course, carried out in the same way.

The rolling pitch diameter D_1, helix angle ψ_1, transverse tooth thickness t_1, and circular pitch p_{t1} of pinion are calculated using data taken from the table on page 170 of May MACHINERY and Equations (8), (6), (7), and (9) for each assumed value of ϕ_1. According to the given data, $D_2 = 1.5$ inches; $\phi_2 = 20$ degrees; $\psi_2 = 23$ degrees; $t_2 = 0.094513$ inch; $p_{t2} = 0.196349$ inch; and $\phi_1 = 19$ degrees.

As shown in the table, for $\phi_1 = 19$ degrees:

$$\frac{D_1}{D_2} = \frac{\cos \phi_2}{\cos \phi_1} = m = 0.993838$$

$$\theta = \text{inv. } \phi_2 - \text{inv. } \phi_1 = 0.002189$$

$$D_1 = 1.5 \times 0.993838 = 1.490757 \text{ inches for pinion} \quad (7)$$

$$\text{Tan } \psi_1 = 0.993838 \times 0.424475 = 0.421859 \quad (6)$$

$\psi_1 = 22$ degrees 52 minutes 22.3 seconds for pinion

$$t_1 = 0.993838\,[0.094513 + (1.5 \times 0.002189)] \quad (9)$$

$t_1 = 0.097194$ inch for pinion

$$p_{t1} = 0.196349 \times 0.993838 = 0.195139 \text{ inch for pinion} \quad (8)$$

The normal circular pitch p_n, normal tooth thickness t_n, and normal pressure angle ϕ_n of the pinion are now calculated, using Equations (2), (4), and (5). Rules (1) and (2) (page 167, May MACHINERY) are then applied to this data to obtain the corresponding cutter data. According to the given data, $p_t = 0.195139$ inch; $t = 0.097194$ inch; $\phi_t = 19$ degrees; and $\psi = 22$ degrees 52 minutes 22.3 seconds.

$p_n = 0.195139 \times 0.921370 = 0.179795$ inch for pinion (2)

$t_n = 0.097194 \times 0.921370 = 0.089552$ inch for pinion (5)

$\text{Tan } \phi_n = 0.344328 \times 0.921370 = 0.317253$ (4)

$\phi_n = 17$ degrees 36 minutes 6.4 seconds for pinion

According to Rule 1, the normal circular pitch for the cutter will then be 0.179795 inch and the normal pressure angle for the cutter 17 degrees 36 minutes 6.4 seconds—the same as for the pinion.

Applying Rule 2 and assuming that no extra cutting allowances are to be made, the normal tooth thickness of the cutter is equal to

$t_n = 0.179795 - 0.089552 = 0.090243$ inch

The cutter helix angle ψ is obtained by applying Rule (3) (page 167, May MACHINERY) to Equation (3). The cutter circular pitch p_t, pressure angle ϕ_t, and tooth thickness t in the transverse plane can then be calculated using Equations (2), (4), and (5). The cutter rolling pitch diameters D_1 are obtained from Equation (1), substituting D_1 for D. The m and θ values for the cutter that correspond to the pinion m and θ values given in the table on page 170 of the May number are calculated. The given data is: $p_x = 0.803463$ inch; $p_n = 0.179795$ inch; $t_n = 0.090243$ inch; $N = 157$ teeth; $\phi_n = 17$ degrees, 36 minutes, 6.4 seconds.

According to Rule 3, p_x is constant for all values of D for a given cutter. Then

$$\text{Sin } \psi = \frac{0.179795}{0.803463} = 0.223775 \quad (3)$$

$\psi = 12$ degrees, 55 minutes, 51.2 seconds for cutter

$$p_t = \frac{0.179795}{0.974641} = 0.184473 \text{ inch for cutter} \quad (2)$$

$$t = \frac{0.090243}{0.974641} = 0.092591 \text{ inch for cutter} \quad (5)$$

$$D_1 = \frac{0.184473 \times 157}{3.141593} = 9.218972 \text{ inches for cutter} \quad (1)$$

$$\text{Tan } \phi_t = \frac{0.317253}{0.974641} = 0.325507 \quad (4)$$

$\phi_t = 18$ degrees, 1 minute, 49.5 seconds for cutter

The values of m and θ for the cutter are calculated next. According to the given data, $D_1 = 9.218972$ inches; $D_2 = 9.269997$ inches; $\phi_1 = 18$ degrees, 1 minute, 49.5 seconds; and $\phi_2 = 18$ degrees, 58 minutes, 31.6 seconds.

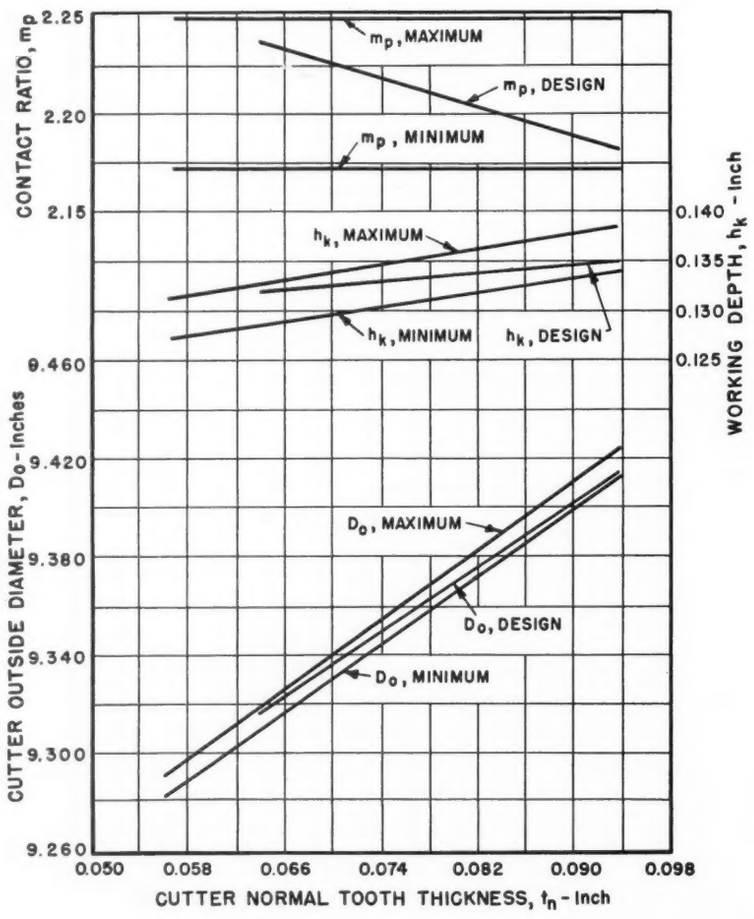


Fig. 6. Maximum and minimum cutter outside diameters, working depths, and contact ratios for a range of cutter normal tooth thicknesses

$$m = \frac{\cos \phi_2}{\cos \phi_1} = \frac{D_1}{D_2} = \frac{9.218972}{9.269997} = 0.994495$$

$$\theta = \text{inv } \phi_2 - \text{inv } \phi_1 = 0.12664 - 0.010817 = 0.001847$$

The transverse tooth thickness t_2 at the pitch diameter obtained in the basic data is calculated next using Equation (9). The normal tooth thickness t_n is then calculated using Equation (5). Given data: $t_1 = 0.092591$ inch; $D_1 \div D_2 = 0.994495$; inv ϕ_2 — inv $\phi_1 = 0.001847$; $D_2 = 9.269997$ inches; and $\psi = 13$ degrees.

Then

$$0.092591 = 0.994495\ [t_2 + (9.269997 \times 0.001847)] \quad (9)$$

$$t_2 = 0.075981 \text{ inch for cutter}$$

$$t_n = 0.075981 \times 0.974370 = 0.074034 \text{ inch for cutter} \quad (5)$$

Step 4 — Calculating Outside Diameter of Cutter for Various Rolling Pitch Diameters

The first step in calculating the outside diameter of the cutter is to apply Equations (12) and (13), using D_p and ϕ_p for the gear rolling conditions. The shaving diameter D_s on the gear is used for D. The value of D_s is assumed to be equal to D_u. Given data: $D_s = 1.412612$ inches; $D_p = 1.490757$ inches; and $\phi_p = 19$ degrees.

$$X = \frac{\sqrt{1.412612^2(1+0.344328^2) - 1.490757^2} - 1.490757 \times 0.344328}{2\,(1 + 0.344328^2)} \quad (13)$$

$$X = -0.185417 \text{ inch}$$

$$h = -0.185417 \times 0.344328 = -0.063844 \text{ inch for pinion} \quad (12)$$

The h coordinate is transferred to the cutter by reversing its sign. The cutter outside diameter D_o is then calculated using Equations (10), (11), and (12). D_p and ϕ_p are taken for the cutter rolling conditions. Given data: h (pinion) = —0.063844 inch; ϕ_p (cutter) = 18 degrees 1 minute 49.5 seconds; and D_p (cutter) = 9.218972 inches.

Then

$$h = +0.063844 \text{ inch for cutter}$$

$$X = \frac{0.063844}{0.325507} = 0.196137 \text{ inch for cutter} \quad (12)$$

$$Y = 0.063844 + \frac{9.218972}{2} = 4.67330 \text{ inches for cutter} \quad (10)$$

$$\left(\frac{D_o}{2}\right)^2 = (0.196137)^2 + (4.673330)^2 \quad (11)$$

$$D_o = 9.354888 \text{ inches for cutter}$$

Step 5 — Calculating Working Depth and Contact Ratio

The working depth h_k for the various rolling pressure angles is calculated using Equation (14). Given data: D_o (cutter) = 9.354888 inches; D_1 (cutter) = 9.218972 inches; D_o (pinion) = 1.6250 inches; D_1 (pinion) = 1.490757 inches.

$$h_k = \frac{1}{2}\ [(9.354888 - 9.218972) + (1.6250 - 1.490757)] \quad (14)$$

$$h_k = 0.135080 \text{ inch}$$

The contact ratios m_p are found from Equation (15) after calculating X_G and X_C using Equation (13). All terms are taken at the rolling conditions. Given data: D (pinion) = 1.625 inches; D_p (pinion) = 1.490757 inches; ϕ_p (pinion) = 19 degrees; ψ_G (pinion) = 22 degrees, 52 minutes, 22.3 seconds; D (cutter) = 9.354888 inches; D_p (cutter) = 9.218972 inches; ϕ_p (cutter) = 18 degrees, 1 minute, 49.5 seconds; ψ_G (cutter) = 12 degrees, 55 minutes, 51.2 seconds; $\phi_n = 17$ degrees, 36 minutes, 42.5 seconds; $p_n = 0.179795$ inch.

$$X_G = \frac{\sqrt{1.625^2(1+0.344328^2) - 1.490757^2} - 1.490757 \times 0.344328}{2\,(1 + 0.344328^2)} \quad (13)$$

$$X_G = 0.152821 \text{ inch}$$

$$X_C = \frac{\sqrt{9.354888^2(1+0.325507^2) - 9.218972^2} - 9.218972 \times 0.325507}{2\,(1 + 0.325507^2)} \quad (13)$$

$$X_C = 0.196138 \text{ inch}$$

$$m_p = \frac{\dfrac{0.152821}{0.921370} + \dfrac{0.196138}{0.974641}}{0.179795 \times (0.953182)^2} \quad (15)$$

$$m_p = 2.247282$$

Step 6 — Checking to Determine the Cutter Dimensions that Will Best Meet Design Requirements

Steps (4) and (5) are repeated using the same gear rolling pressure angles but with D_s now equal to D_f.

The results of these calculations are tabulated on the next page and plotted in Fig. 6. This chart shows the maximum and minimum cutter outside diameters D_o, working depths h_k, and contact ratios m_p for a range of cutter normal tooth thicknesses t_n.

The total amount of stock that may be ground off the shaving cutter tooth for sharpening purposes determines the life of the cutter. For this cutter, it will be assumed that the normal tooth thickness may be reduced 0.030 inch. The useful range of cutter outside diameters is determined

D_s = 1.4126 inches = under-cut diameter				
ϕ_1, Degrees	t_n, Inch	D_o, Max., Inches	h_k, Max., Inch	m_p, Max. Ratio
20	0.0937	9.4229	0.1389	2.247
19	0.0740	9.3549	0.1351	2.247
18	0.0564	9.2909	0.1315	2.247
D_s = 1.4144 inches = form diameter				
ϕ_1, Degrees	t_n, Inch	D_o, Min. Inches	h_k, Min. Inch	m_p, Min. Ratio
20	0.0937	9.4136	0.1343	2.172
19	0.0740	9.3461	0.1307	2.172
18	0.0564	9.2826	0.1273	2.172

by the tooth thickness range and maximum working depth permissible.

Examination of Fig. 6 shows that for a given tooth thickness the cutter outside diameter and working depth may be varied several thousandths of an inch to suit various limitations and still shave between the point of deepest undercut and the form diameter on the gear.

The clearance in the root of the gear tooth is 0.025 inch. It will be assumed that 0.010 inch of this can be used by the cutter to give a maximum working depth of 0.135 inch. The contact ratio is apparently high enough for this design to give satisfactory shaving action.

The design curves are then based on a working depth for a new cutter of 0.135 inch at a normal tooth thickness for the cutter of 0.0937 inch. For these values, the cutter outside diameter is 9.415 inches and the contact ratio is 2.183. Each design curve is drawn so that, if extended, it would pass through the point having a value computed for $\phi_1 = 18$ degrees on the corresponding curve for $D_s = 1.4126$ inches, but it is terminated at a tooth thickness of 0.0637 inch, which is established by the allowable tooth thickness range of 0.030 inch for this cutter.

It will be seen from Fig. 6 that the values on these design curves for a new cutter are close to the allowable minimum, and for a used or worn-out cutter they are close to the allowable maximum. A discussion of these examples will be given in the next article.

The third article in this series will describe how to determine if a shaving cutter on hand is applicable to a gear having slightly different data from that for which the cutter was designed.

* * *

Today's passenger cars contain over four hundred wire springs of approximately 180 different designs.

Shop Practice Bulletins Published by Department of Commerce

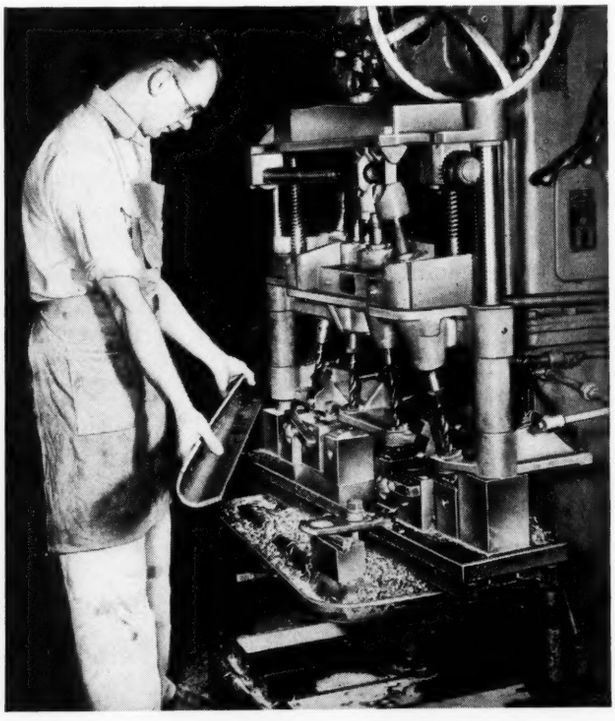
A miniature "shop men's" library for metalworking plants has been brought out by the U. S. Department of Commerce. Such subjects as grinding, milling, spinning, honing, and tapping; soldering, brazing, and welding; working with plastics and alloys; plating and finishing; and care and maintenance of equipment are covered in fifty-four bulletins originally prepared for National Defense Department shops.

The bulletins range from two to twenty pages, and cost 10 cents for pamphlets under five pages; 25 cents for five to ten pages; and 50 cents for those over ten pages. Anyone interested can obtain a list of the bulletins by writing for "Industrial Notes Circular" to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

* * *

Special Fixed-Center Angular Drill Head Solves Production Problem

The fixed-center drill head here illustrated was made by the Thriftmaster Products Corporation of Lancaster, Pa., for the Allis-Chalmers Mfg. Co., of La Porte, Ind. It was designed for drilling four 5/8-inch holes in an alloy-steel part at angles varying from 4 to 13 degrees on each side of the perpendicular. The part drilled is a component of the "Forage Harvester."



Special angular drill head used for production drilling job on a harvesting machine part

Inspecting Angular-Contact Bearings Under Pre-Load Conditions

By F. C. VICTORY, Chief Engineer
Moore Special Tool Co., Inc.
Bridgeport, Conn.

EXPERIENCE has shown that there are frequently discrepancies in the results obtained when an angular-contact bearing is inspected in the free, or non-pre-loaded, condition and when the same bearing is inspected with the working pre-load applied. Performance characteristics of assembled bearings and spindles prove that bearings acceptable under pre-loaded inspection conditions will also be acceptable in final assembly inspection. It is quite common for bearings to pass a non-pre-loaded inspection and yet be unsatisfactory when assembled and pre-loaded. Therefore, all inspection procedure for angular-contact bearings used in the precision equipment made by the Moore Special Tool Co., Inc., Bridgeport, Conn., duplicates service conditions as nearly as possible.

In general, the bearings used in this equipment are required to be accurate to within 0.0001 inch as regards eccentricity or face run-out of either inner or outer race. For spindles of relatively low speed, say 2500 R.P.M., a rather close degree of conformity of ball radius and race curvature is desirable, since this results in a more stable or self-centralizing bearing. Generally 51 to 52 per cent is an acceptable value for this factor. However, in the case of higher speed spindles (for example, 50,000 R.P.M.), such a close conformity would result in excessive heating, and is not necessary because of the relatively light work load.

As previously stated, bearing inspection is performed under pre-load conditions approximating those applied in assembly. This is accomplished by means of fixtures such as those shown in the accompanying illustrations. Fig. 1 illustrates a section through the fixture used for checking concentricity and face run-out of the outer race of a bearing under a pre-load of 200 pounds.

Essentially, the fixture consists of an open rectangular frame horizontally supported above a baseplate. The bearing to be inspected is seated on a close fitting stud *F*, which locates the inner race concentric and square with the center line of the fixture. A thrust cap *E* contacts the opposite face of the outer race and is located on the bearing by means of three equally spaced

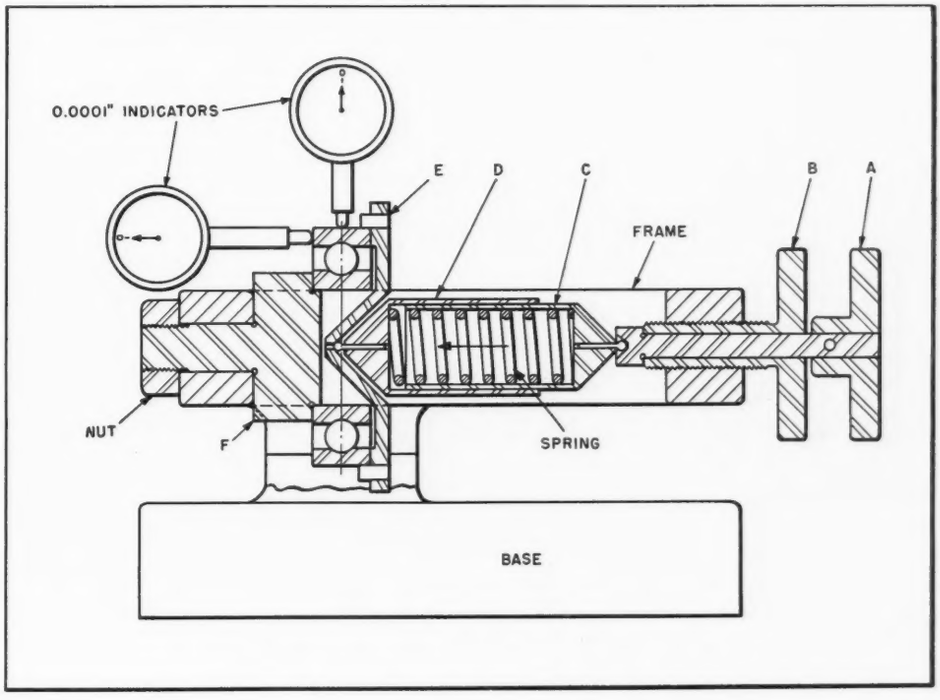


Fig. 1. Section through a fixture used for checking concentricity and face run-out of the outer races of angular-contact bearings under 200 pounds pre-load

Fig. 2. Bearing (A) shown in fixture before assembling calibrated spring cartridge (B) which transmits load to thrust plate (E)

pins which engage its periphery. This cap is so constructed that the point of thrust applied axially comes to the left of the pitch line of the bearing, thus rendering the thrust negligible as far as the factors being inspected are concerned.

Thrust is applied by means of a spring cartridge consisting of an outer shell *D* and a telescoping inner shell *C*. This cartridge is calibrated for spring pressure, and the inner shell is graduated in pounds by a linear scale, which is read against the edge of the outer shell. The thrust applied to the cartridge is transmitted through it to cap *E* by spherical-ended pins in each end of the cartridge, in order to concentrate the thrust at the desired location.

Load is applied to the cartridge and thence to the bearing by means of the combination screw and knob *B*, which is fitted in a tapped hole in line with the bearing supporting stud in the opposite end of the rectangular frame. It will be noted that the thrust pin attached to knob *A* has a female center in which the cartridge pin is seated. This thrust pin bears against the end of *B* and is free to turn within the latter. Thus it is possible to turn knob *B* and compress the cartridge until the correct pre-load is attained, as indicated by the graduations.

At this point, knob *A* is turned, and without moving knob *B*, the cartridge, cap *E*, and the outer race of the bearing are rotated under constant pre-load. Dial indicators in contact with the face and outside diameter of the outer race show the magnitude of face run-out and eccentricity of this member. Fig. 2 shows this fixture with a bearing in position before assembling the thrust cap *E* and the cartridge.

The method of checking the inner race is essentially the same. The rectangular frame of the fixture used for this purpose contains a pocket at one end in which the bearing is seated, being located by its periphery and against the face of the outer race. A thrust cap fits in the bore of the inner race and contacts the exposed face of the race. Pre-load is applied in the manner previously explained, and the necessary readings are taken with a similar indicator set-up. This fixture is illustrated in Fig. 3.

In order to check the squareness of face of the inner race with the bore, the bearing is mounted on a slightly tapered arbor which is held between centers in the fixture shown in Fig. 4. By placing an indicator against the face of the inner race and rotating the arbor, the amount of run-out of the face can be readily determined.

The average diameter and out-of-roundness of the outer race of a bearing are checked by setting a dial indicator to zero against a size-block equal

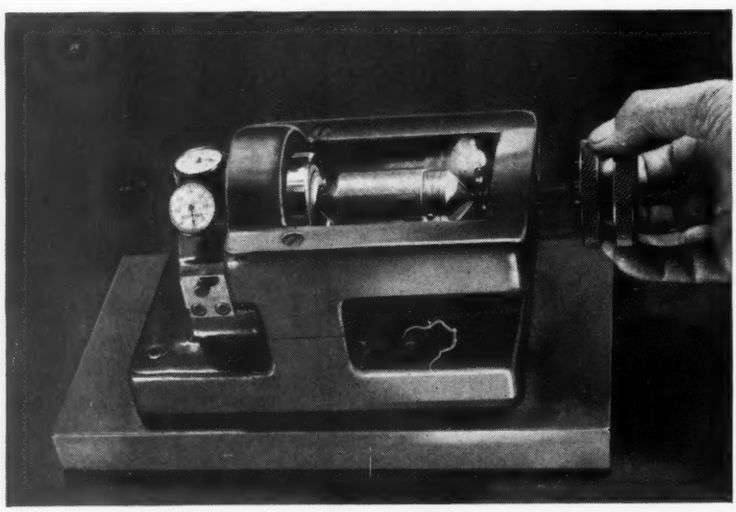


Fig. 3. Fixture used for the pre-load checking of concentricity and face run-out of the inner races of angular-contact bearings

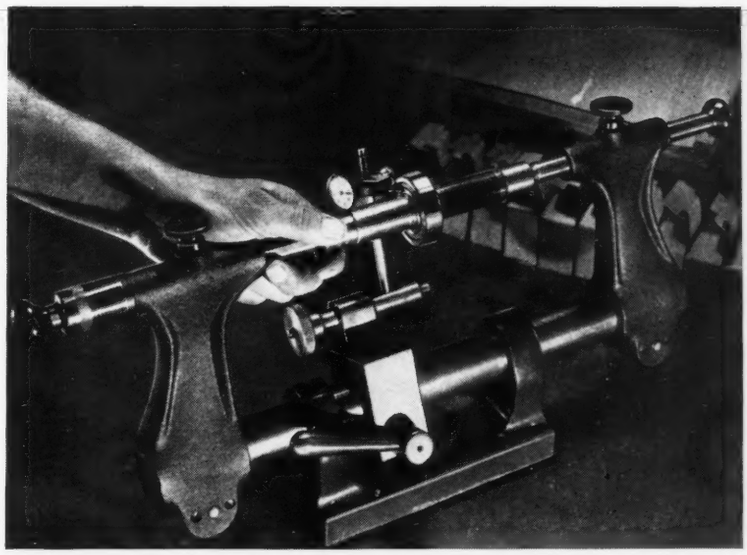


Fig. 4. The squareness of the face of the inner race of a bearing with the bore is checked by means of a dial indicator. The bearing is mounted on a slightly tapered arbor, which is held between centers and rotated

to the nominal outside diameter of the bearing, thus establishing a standard for size. The bearing is then placed under the indicator, and readings are taken at numerous points on the periphery, from which the out-of-roundness and average diameter values can be determined.

Parallelism of the faces of the outer and inner races relative to each other can be inspected by means of the set-up shown in Fig. 5. The bearing is supported on a gaging plate and the dial indicator point is brought into contact with the face of the races. The bearing is then turned, so that the entire face of each race is brought under the indicator, thus registering the degree of parallelism of those surfaces. Fixed buttons on the gage plate hold the bearing in position while it is being turned.

For establishing the length of the inner and outer spacers required to pre-load each pair of bearings to a predetermined value, it is necessary to measure the offset or axial projection of one race relative to the other under the same amount of pre-load or axial thrust. The fixture used for this purpose, Fig. 6, utilizes a calibrated spring cartridge, as in the previous cases, and is practically a vertical arrangement of the fixture

Fig. 5. Inspecting parallelism of both outer and inner race faces of bearings by rotating bearings between stationary buttons on a gage-plate and taking readings with a dial indicator that contacts the faces

Fig. 6. Measuring the axial offset of the inner and outer races of a pair of bearings under a predetermined pre-load to ascertain the length of spacers required to produce the same amount of pre-load

shown in Fig. 1. The bearing is supported on a vertical shouldered stud, and pressure is applied through a cap similar to that indicated at *E* in Fig. 1, except that the cap in this application has cutaway sections, permitting the indicator to contact the upper face of both races at two points opposite each other.

By applying axial thrust to duplicate the pre-load desired, the faces of the races are forced to assume the same axial offset in relation to each other as is necessary to duplicate this pre-load when assembled with inner and outer spacers. Therefore, by applying the indicator to the faces of both races the difference in offset can be measured and spacers made to suit.

* * *

Magazine Feed Applied to Fine-Pitch Gear Shaper

Automatic loading and ejection of the work is a feature of the Fellows fine-pitch gear shaper shown in the accompanying illustration. A magazine, manually loaded with gear blanks, is placed on a slide on the machine. Pressure is exerted on the blanks by a pusher, which is actuated by a small-diameter wire rope passing over a pulley and connected to a weight. A yoke, mounted on a vertical shaft, advances the slide that carries the magazine into position to align a gear blank with the driving and supporting centers.

The supporting center descends to clamp the gear blank, the magazine is withdrawn, and the gear-cutter advances to the pre-set depth. Reciprocation of the cutter need not be stopped, since the tool is withdrawn from the work during loading.

Two methods are employed for ejecting the work from between the centers. For brass gears, a blast of compressed air blows the work into the chute, while for steel gears, oil pressure is used for ejection.

* * *

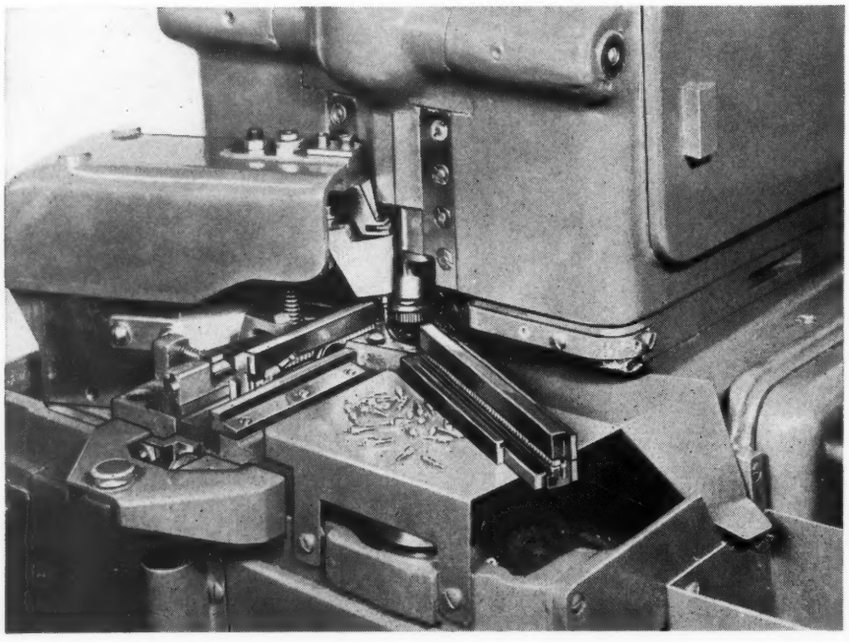
New American Bolt Standard

A new standard for high-strength, high-temperature internal wrenching bolts has been developed by an American Standards Association committee, jointly sponsored by the American Society of Mechanical Engineers and the Society of Automotive Engineers.

As the name indicates, these bolts are intended for applications where high strength is required under high-temperature conditions, such as in steam turbine assemblies. The bolts have a round head with a hexagonal recess, the head being larger than that of regular socket-head screws. When the round bolt head is located in a counterbore, it can be peened to lock it against rotation. This standard lists bolts in nominal diameters from 3/8 inch to 2 inches. Copies of the standard are available for 35 cents from the American Standards Association, 70 E. 45th St., New York 17, N. Y.

* * *

The volume of sales in the gearing industry for March, 1950, according to reports by the American Gear Manufacturers Association, showed an increase of 31.3 per cent, compared with February, 1950.



Fine-pitch gear shaper provided with magazine feed for automatic loading of gear blanks. A loaded magazine is seen on the table, while another magazine is shown in the feeding position

How to Estimate Profits and Losses in the Job Shop

Last in a Series of Articles on Estimating Machining Costs in the Job Shop, Covering All the Basic Types of Machine Tools

By HERBERT W. BROWN
Management Consultant

IN the preceding articles of this series, charts have been developed for estimating the time for various machining operations, such as planing, shaping, boring, turning, and milling. The main objective of these charts is to establish a means by which the time required for a given operation may be conveniently determined. The time shown in the charts for a particular operation was based upon selected machining conditions, and was adjusted to suit variations in the conditions by means of conversion factors.

This system having been established, it becomes a simple matter to set up additional charts for any machine tool or machining operation not taken into consideration heretofore.

To develop estimating charts for surface grinding, for example, data similar to that used in setting up tables for planing operations (see MACHINERY, June, 1949, page 159) can be used. A chart showing the time in minutes for different lengths of table travel will be required for both rough- and finish-grinding, allowing for the difference in speed between traverse and return strokes. A second table would be based upon a selected rate of feed per stroke, and used in conjunction with the first table, would show the time required to rough- and finish-grind work of a given width and length under selected grinding conditions. A delay allowance factor is also used in calculating the time given in this table in order to take into consideration essential interruptions, such as measuring, adjusting, etc.

The third table required provides conversion factors to be applied to the time given in the second table in order to find the estimated time under actual working conditions. This table lists various recommended feeds per stroke for different materials under various set-up conditions. The conversion factors are determined by dividing the charted feed per stroke (the feed upon which the time in the second table is based) by the actual feed per stroke. The time in the second table is multiplied by these factors to arrive at the actual time required.

Another example of the application of this system for estimating machining operations is in cylindrical grinding. In this case, tables similar to those set up for estimating the time required for turning operations (MACHINERY, January, 1950), can be used. Based upon a convenient grinding feed and speed, in order to tabulate data for a wide range of different conditions, the first table would give the time required for the cylindrical grinding of work of different lengths and diameters, making allowances for delays and essential interruptions. A second table, showing recommended speeds and feeds for various materials and set-ups, would be used with the first table. Conversion factors, determined in the same manner as previously described, would be shown in the second table and would be used to adjust the time given in the first table according to working conditions.

No attempt has been made in this system to develop formulas for estimating handling or set-up time because of varying shop conditions. Piece handling has been considered part of the set-up time for one- or two-piece production, and should be estimated separately on the basis of conditions existing in a particular shop. Bench work, such as lay-out, assembly, etc., must also be estimated on a similar basis.

In estimating time for large quantity production, handling time should be considered on a unit basis and should be estimated apart from machining time, as in the case of single-unit production. The data set forth in this series of articles is principally for estimating the machining time alone, required on single or very limited quantity production. However, by adjustment of the delay allowance factors incorporated as part of the basic time tubulated for any given machining operation, charts can be developed for larger quantity production in such work as non-repetitive job lots, where a time study would be uneconomical.

In estimating quantity production lots, less allowance should be made for such essential de-

lays as measuring, adjusting and tool grinding. Moreover, these allowances must be determined in accordance with conditions in the individual shop. An attempt to prescribe fixed percentages of delay allowances without such knowledge would be impractical. Set-up time, of course, would be spread over the total quantity of parts to be machined.

The cost of tooling should be taken into consideration when large quantities are to be produced, and it should be determined whether such tooling can be amortized in the course of completing a contract. If the cost of special jigs and fixtures can be absorbed as the result of time saved by their use, they should be built and used, not only because of this saving, but also because greater uniformity of quality will be obtained, considerably reducing costs due to spoilage. To determine the efficiency of such a choice, tooling costs may be estimated in a similar manner to that used for estimating the parts to be machined, and the result compared with labor costs in handling, setting up, etc., without special tools.

An estimate sheet similar to that published in June, 1949, MACHINERY, page 164, may be used to record the time estimate for shop purposes. This form shows the proposed type of tool or cutter, machine tool, speeds, feeds, number of cuts, machining and set-up allowance time, and a description of how the machining is to be performed. It is highly desirable that the method of machining on which the estimating is based be recorded and be made available to the shop. Inasmuch as shop supervision is an expense item, time spent in supervising each job should be kept to a minimum by providing definite information on the machining methods to be followed.

This also eliminates or at least reduces job planning in the shop after the estimating based on a certain method of doing the job is finished. Without some record of the method upon which an estimate is based, the shop personnel may do the job in an entirely different manner, often without carefully planning it, so that the estimated time falls far below the actual time expended. Of course, the estimator must exercise great care in planning the work so that it is done in the most efficient manner possible, without requiring further time to be spent in planning by others.

Sometimes it is advisable to prepare copies of the estimate sheet for sales personnel, the accounting department, and such other departments as may be interested in quotations and estimated costs. It is also desirable that the actual time required for each machining operation be entered on a copy of the estimate sheet and compared with the estimated time. This practice will bring to light time losses at their source, where corrections in methods can be made immediately, so that there is, in effect, a program of perpetual improvement in the shop.

In order to identify the particular operation where a loss occurs, the actual time required may be recorded on the estimate sheet in a column adjoining each operation. This notation can include the operator's identification and may be

Job Cost Estimate Sheet

Est. No. 3125

Customer: Smith Mfg. Co. Date 3/17/49

Address: 1243 Irving Rd., Chicago, Ill. Shop Ord. 7334

Description of Job.....Yoke No. 3-4159-B

Operation	Estimated Time, Min.	Actual Time, Min.	Gain, Min.	Loss, Min.
Cut Stock	75	65	10	..
Lathe	525	550	..	25
Shaper	...	...	..	..
Planer	...	...	..	..
Mill	465	420	45	..
Bore	210	190	20	..
Drill	...	...	..	..
Grind, Surface ..	...	...	..	..
Grind, Cylindrical	...	...	..	..
Heat-Treat	...	...	..	..
Bench—Lay-out, Burr	90	95	..	5
Assembly	...	...	..	..
Total Minutes ...	1365	1320	75	30
Total Hours	22.75	....	Hourly Rate $4.52	Estimated Cost $102.83
Material Cost ...	Weight 180 lbs.	Quantity	Cost per lb. $0.114	$20.52

Estimated by BWH	Approved by GEB	Total Estimated Cost, $123.35

Typical cost estimating form, showing estimated and actual time required to perform individual machining operations for a particular job. Estimated total cost is based on estimated time multiplied by shop hourly rate

entered by the timekeeper at the completion of each operation.

To show clearly the relationship between estimates and costs, and to be sure that quotations, or bids for prospective work, are made on a sound basis, estimates are often expressed in terms of dollar cost. Many shops apply a machine-hour rate that represents the amount the shop must earn per hour in order to operate successfully. This rate is determined by considering the owner's investment, overhead expenses, direct labor costs, etc., and remains fixed for a given period of time, so that all estimates may be multiplied by it to arrive at a quotation after a percentage of profit has been added.

It is important that the data used in determining the hourly rate be analyzed carefully from time to time, so that it can be adjusted as changes occur in the factors that influence it. This hourly rate may be calculated by dividing the total operating expenses of a shop over a given period of time, say a year, by the total productive hours expended in that period of time. Total operating expenses comprise wages, material costs, and all other operating costs, including overhead expenses, such as sales commissions, advertising, shop supplies, cost of supervision, maintenance, etc. Total productive hours are those expended by all production employes over a period of time.

For example, assume the total productive hours for a given shop to be 75,391 hours for one year and the total operating expenses to be $177,922.76. Based on these figures, the hourly rate to be used thereafter would be 177,922.76 $\div$ 75,391 = $2.36 per hour. After multiplying the estimated time for a job by this figure, the cost of materials, heat-treating, and any machining done outside the plant would be added to the quotation, plus a percentage for profit.

If, through more efficient methods, work is done in less time than is estimated, the amount earned will exceed the required hourly rate. For example, if it is estimated that a job will require 40 hours at an hourly rate of $2.36 per hour, and only 31 hours are actually expended in doing it, an hourly rate of $3.04 has been earned. Conversely, a loss occurs if the estimated time is less than that actually required. By applying an hourly rate to each job, the exact gain or loss can be determined immediately.

In the preparation of bids for prospective work, it is desirable to classify the machining operations according to the machine tool to be used. In this way, the time expended at each machine and the cost involved are clearly shown, so that when a job is finished, gains or losses at each machine are evident.

A typical cost estimate sheet used for preparing quotations is shown in the accompanying illustration. This form differs from the time estimate sheet previously mentioned in that it does not show an analysis of machining operations on each machine, but gives the total time spent on each operation, and the resulting cost based upon the hourly rate. It will be noted that the hourly rate shown on this form is $4.52. The profit factor is intentionally omitted, since it may be included in calculating the hourly rate or it may be added separately to the quotation at the discretion of the management.

It may be desirable to establish a factor for showing the cost of the material. This can be accomplished by converting the dollar value of the material into minutes. For example, the material cost shown on the form is $20.52 which is equal to 273 minutes at the rate of $4.52 per hour. The illustrated form may be changed to incorporate this method of showing material costs if it is desired.

In this example, the net gain of 45 minutes would indicate that the job was profitably completed. It is extremely important to bear in mind, however, that the cost of operating machine tools varies according to the initial investment, depreciation costs, floor area used, power consumed, insurance, taxes, etc. A time loss on a more expensively operated machine tool may more than offset the gain shown by another machine tool.

Some manufacturers prefer to establish hourly rates according to individual machines or like groups of machine tools. This results in more accurate cost estimating, and since each quotation is based on the equipment to be used for a particular job, a customer whose work requires only the use of a vise will not be offered a bid similar to that given a customer whose work requires the use of an expensive machine tool, even though the time involved is the same.

Whichever method is used, it is necessary to employ factors based on actual operating conditions. Often allowances are added to a cost estimate in order to assure profit margins when there is doubt about some of the factors involved. Attempts are sometimes made in this way to allow for spoilage or salvage expense, extra time to complete a contract, variations in operating rates, lost time, and other contingencies.

Actually, close control over shop operations is necessary to meet these problems, because all factors cannot be predicted with consistent accuracy. If cost estimating information is accurate and carefully based upon all the available data, a shop will have assurance that contracts can be fulfilled profitably.

Engineering News

Low-Temperature Testing of Ball-Bearing Lubricants

Lubricants for ball bearings in aircraft gun turrets and similar applications must be effective at temperatures as low as 65 degrees below zero. The testing of lubricants for such use has been simplified by a compact, semi-portable device developed by the General Electric Co., which eliminates the need for elaborate cold rooms.

The heart of the device is a cooling chamber consisting of two buckets, one large and one small, with space between which is filled with dry ice. A transparent plastic lid covers the unit. In testing, a ball bearing is placed on a spindle in the inner bucket and rotated by a small electric motor. The tendency of the outer ring of the ball bearing to move with the inner ring is measured by a strain gage. If a lubricant under test thickens in the cold atmosphere, the inner ring will not turn freely, and the gage will register a greater strain on the outer ring.

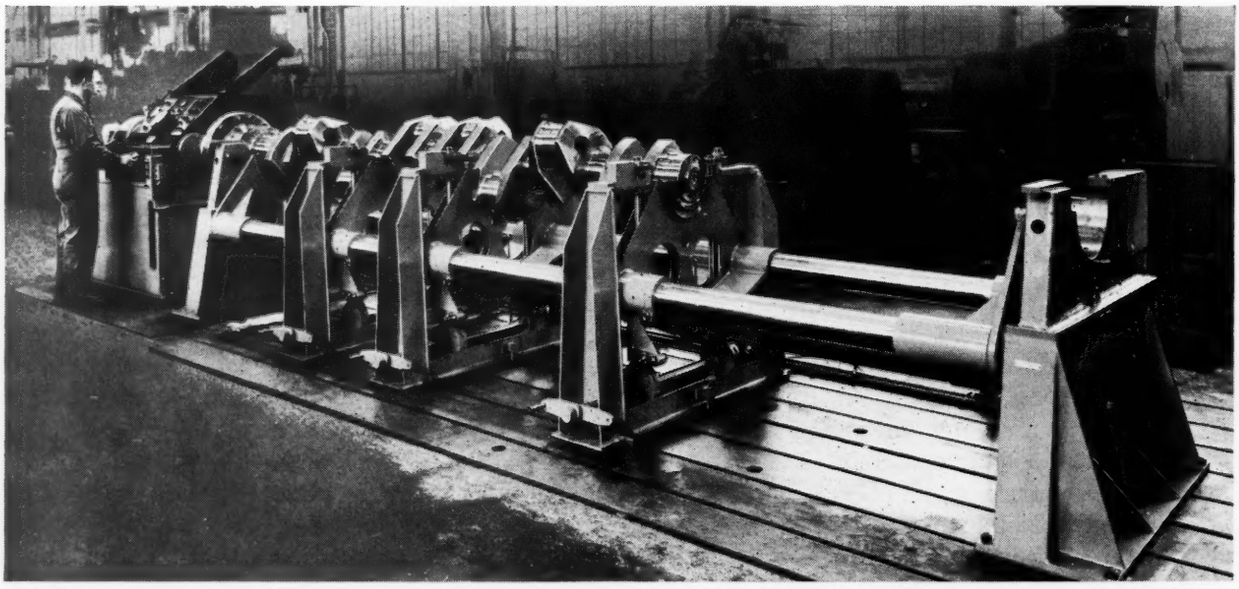
New Jet Engine Laboratory that Simulates Flight Conditions

A new ram jet engine laboratory, designed and constructed by Wright Aeronautical Corporation, Wood-Ridge, N. J., under a contract from the U. S. Air Force, can simulate flight speeds up to 2600 miles per hour and altitude conditions of 80,000 feet. Ram jet engines up to 20 inches in diameter can be operated in the main test chamber, and future modifications will make it capable of testing units twice this size.

The central test cell is a steel tank 12 feet in diameter and 96 feet long. The engine to be tested is mounted on a platform in the center of the chamber, and is connected to an electronic thrust measuring instrument.

Fuel pumps for supplying engines on test are capable of delivering more than 6000 gallons of gasoline per hour, and steam at the rate of 150 tons per hour is fed to the exhaust system through a series of steam jets to aid or retard the escape of gases from the rear of the engine. Air for this test chamber is supplied from a nearby Gas Turbine Development Laboratory at the rate of 140 tons per hour and passes through a surge chamber that reduces turbulence on the way. By varying the incoming air pressure and the outlet pressure, it is possible to create within the engine the simulated effect of altitude or speed.

A cooling system which jackets the chamber with a layer of circulating water was built as an integral part of the tank to absorb some of the great heat created by a ram jet engine. This



Balancing a 4790-pound crankshaft for an eight-cylinder supercharged Diesel engine on a Gisholt Dynetric balancing machine at the Baldwin Locomotive Works, Eddystone, Pa. The amount and location of the dynamic unbalance are measured to an accuracy of 1 pound-inch. This is equivalent to a measurable displacement of 0.0002 inch at either end of the holding cradle

A portable instrument for separating steel products of different grades that have become mixed has been developed by the research department of the Jones & Laughlin Steel Corporation, and is manufactured by the Fisher Scientific Co., Pittsburgh, Pa. The instrument, called the Fisher Steelsorter, differentiates between all types of carbon steel by responding to magnetic differences in the metals, regardless of whether the differences are chemical, physical, or metallurgical in nature. An untrained operator, using the Steelsorter, can separate several hundred small samples per hour. The instrument can be applied to both semi-finished and finished parts

heat, which reaches 4000 degrees F. in certain parts of the test chamber, causes the chamber to expand as much as one inch over its length; consequently it is mounted on rollers. Three 45-foot silencer stacks muffle the roar of the exhaust.

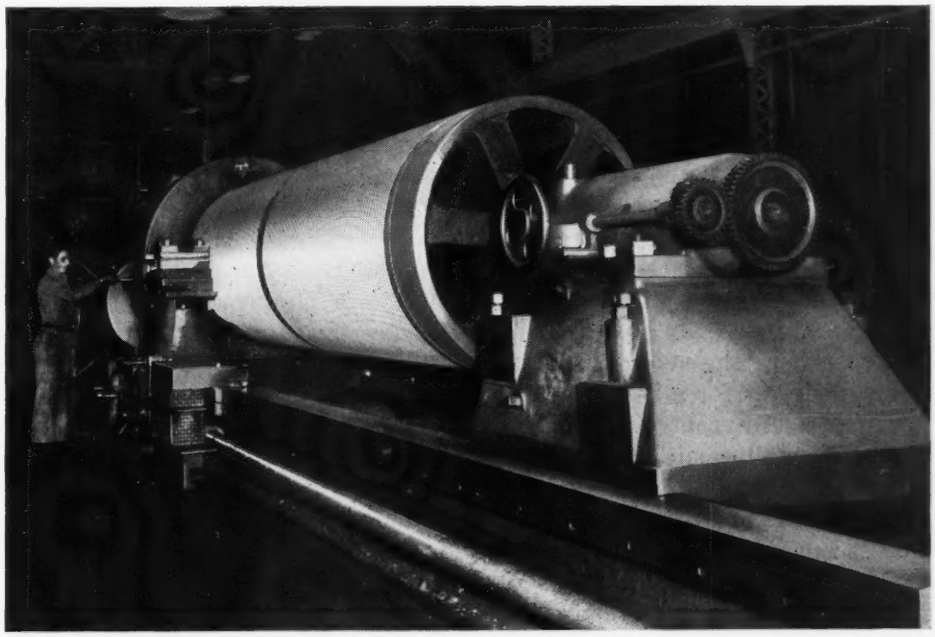
Light-Weight High-Power Turbine Developed by Boeing

A 200-pound turbine capable of developing 160 to 200 H.P. is in an early stage of service tests at the gas turbine department of the Boeing Airplane Co., Seattle, Wash. A conventional Diesel engine in this power range weighs from 2000 to 3000 pounds. Ultimately, the turbine is expected to be applicable to industrial power plants, propulsion of trucks, small boats and airplanes, and auxiliary power needs in the aircraft field.

Air Samples from Upper Atmosphere Analyzed by Mass Spectrometer

Air samples captured from the upper atmosphere, at a height of more than eighteen miles, are being analyzed by the Geophysical Research Directorate of the Air Force Cambridge Research Laboratory at Cambridge, Mass., by means of an analytical mass spectrometer. This instrument was designed and built by the General Electric Co. to aid in the study of the composition of the earth's atmosphere and the development of new weather forecasting techniques.

The new spectrometer uses electric and magnetic fields to sort the sub-microscopic particles making up gases and vapors. It is so sensitive that under some conditions it is said to be able to detect a gas of which there is only 1 part to 100,000 parts of another gas.



Giant hoist drum being grooved at the Cleveland Crane & Engineering Co. The drum, which is a one-piece steel casting, is 15 feet long, 4 feet in diameter, and weighs 11 tons. It will be used on a crane to lift 200-ton loads

Machine Tool Electrification Discussed at Westinghouse Forum

THE fourteenth annual Machine Tool Electrification Forum sponsored by the Westinghouse Electric Corporation, which was held in Buffalo, N. Y., on April 25 and 26, attracted an attendance of 300 engineers and executives from approximately 120 companies. Technical papers presented at the conference dealt with problems and electrical developments of special interest to the machine tool industry.

Effect on Electrical Requirements of Use of Carbide Tools

In a paper presented at the first day's session, entitled "How Carbide Cutting Tools Affect the Electrical Requirements of Machine Tools," E. K. Morgan, electrical engineer, Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., pointed out the machine tool builders' need for greater horsepower, smaller motors, and more dependable operation—all at less cost.

To meet the demands of machine tool users by providing increased horsepower for cutting with tungsten-carbide tools, the cooperation of electrical motor manufacturers is necessary to build motors with smaller physical dimensions, design motors with a wider range of speeds at constant horsepower, streamline their designs to improve the appearance of the machine, furnish simpler and sturdier controls, help sell the user on built-in motors, and improve the methods of heat dispersion.

Electric Controls for Automatic Screw Machines

R. H. Schuman, engineer of the Warner & Swasey Co., Cleveland, Ohio, described the electrical controls employed on his company's single-spindle automatic chucking machine in a paper entitled "Automatic Cycling and Programming as Applied to Automatic Screw Machines." A primary objective in developing this machine was to reduce the set-up time. To accomplish this, the drives for all functions of the machine are electrically controlled, with operation by means of small, easily adjustable dogs. Through conventional switches and push-buttons, the operator can select hand or automatic operation, as well as individual hand operations. Some of the more interesting features of the electrical circuit for the machine were discussed.

The financial side of a machine tool replacement policy was described by L. W. Scott Alter, president and general manager of the American Tool Works Co., Cincinnati, Ohio, in a paper entitled "What to Do About This Equipment Crisis." It was pointed out that three out of every four machine tools in this country will be at least ten years old by 1955 if the present trend of the inadequate replacement of old machine tools continues.

To determine the actual worth of existing machine tools, it is necessary to find out what a willing buyer will pay a willing seller. This is accomplished at the American Tool Works Co. by preparing a plant equipment book that contains an adequate description of each machine. This book is made available at regular intervals to a used machinery dealer who inserts, after each machine, what he is willing to pay if the owner should decide to sell.

From such figures, a valuable survey of one's plant equipment can be made periodically. By plotting the percentage of replacement cost offered by the dealer against the age of any machine, it can be found that the value of the machine—after an immediate sharp drop and then a relatively slow recession—falls off very rapidly from the eighth to the eleventh year of age.

Mr. Alter called attention to the danger of concluding that the tooling-up phase of national preparedness is well in hand now that "Tentative Production Schedules," or so-called "phantom orders" have been issued to machine tool builders. The age or obsolescence of existing machine tools has a most important bearing on the time required for this country's industries to reach peak efficiency.

Electronic Controls on Machine Tools

Applications of standard electronic devices to improve the control of machine tools were described in the paper "Electronic Devices as Components of Machine Tool Control," presented by J. M. Morgan, Jr., electrical engineer of the Cincinnati Milling Machine Co., Cincinnati, Ohio. A quick acting electronic relay which can operate consistently on a signal of only 0.004 second duration is employed to obtain a "pick feed" at either or both ends of the table stroke on one machine.

Electronic time delay relays with remote ad-

justment by means of potentiometers are used on grinding machines for accurate sizing operations. Accurate stopping of headstock spindles in their required angular positions has been accomplished by providing electrical means for obtaining a slow spindle feed, and a "stop" signal from an electronic relay. An electronic automatic sizing device for grinding machines and an electronic device to guard against flame failure on the Flamatic hardening machine were also described.

Activities on the first day of the meeting included a report of the Electrical Committee of the National Machine Tool Builders' Association and a discussion of proposed revisions to Machine Tool Electrical Standards and Joint Industry Conference Standards. Representatives of large users of machine tools, primarily those in the automotive industry, as represented by the Joint Industry Conference, have adopted and published their own electrical standards covering all industrial equipment. The speaker at the annual banquet was Dr. C. C. Furnas, director of the Cornell Aeronautical Laboratory, Buffalo, N. Y., who spoke on "Research in Industry."

Hydraulic Contouring Attachment with Constant Cutting Speed

The second day's program was presented at the Buffalo motor plant of the Westinghouse Electric Corporation. Under the subject "Constant Cutting Speed," R. C. Montanus, vice-president of the Springfield Machine Tool Co., Springfield, Ohio, described the hydraulic contouring attachment for Springfield lathes, while E. B. Ankenmann, consulting and application engineer for the Westinghouse Electric Corporation, discussed the variable-voltage motor-generator set with electronic feed control that is employed for obtaining constant cutting speed on these lathes.

In his paper, Mr. Montanus traced historically the developments in solving the problem of maintaining a constant cutting speed during contour turning, and described the Springfield hydraulic contouring attachment. The adjustable-voltage drive with constant horsepower over a speed range of 6 to 1 selected for the 20-inch heavy-duty lathe provides a constant cutting speed when turning parts from 2 to 12 inches in diameter. Since the constant cutting speed control depends upon the true radial position of the tool, some means had to be provided to interpret the angular motion of the tool-slide in terms of radial change. This was accomplished by a unit consisting of a small, totally enclosed reactor and cam assembly, mounted on the wing of the carriage, and a control arm on the tool-slide.

Broadening the Use of Standard Electrical Equipment on Machine Tools

In a paper entitled "Broadening the Use of Standard Electrical Equipment on Machine Tools," O. G. Rutemiller, Morton Mfg. Co., Muskegon Heights, Mich., suggested the application of packaged adjustable-speed drives and similar standard apparatus on large machine tools that require complex interlocking and special performance characteristics not normally intended with such drives.

Modifications that have been made on the Morton traveling-head planer by using standard drives and a special control panel were described. The same idea has been applied to several smaller machines made by the company, as well as to a special machine designed to face, turn, and thread both ends simultaneously of pipe 11 feet in diameter by 28 feet long.

F. D. Snyder, supervisor, industrial consulting and application engineering, Westinghouse Electric Corporation, presented a paper on "Controlled Deceleration of Alternating-Current Induction Motors by the Use of Direct Current." Although it has long been known that a braking torque is developed if direct current is caused to flow through any part of the stator winding on an alternating-current induction type motor, it has only been in recent years that this principle has been used to any extent.

With direct-current braking, torque is applied smoothly, and automatically drops to a low value near zero speed, thus providing a smooth stop. The braking torque can be adjusted easily up to very high values. When this system of braking is employed, no reversal of motor direction can take place, no mechanically operated switches are required, and there is no change in braking due to mechanical wear.

New developments for the industry, described by J. D. Ellis, D. L. Pierce, and E. C. Watson of the Westinghouse Electric Corporation, included the new type SK direct-current Life-Line motors; alternating-current magnetic, non-reversing De-ion Life-Linestarters; adjustable 0.2 to 200 second, pneumatic time-delay relays; and sectional terminal blocks of the single-circuit type, which can be assembled into strips of any length ranging from one to seventy-five pairs of terminals.

* * *

Electrolytic tin plate, which has largely supplanted the hot-dip method of manufacture in the post-war era, conserves over fifty per cent of the nation's tin supply, according to the American Electroplaters' Society.

Thermostat Assembly Simplified by Special Press Tooling

ACCURACY, uniformity, and rapid output are important factors in the production of water thermostats for automobile cooling systems and automatic washing machines. To simplify the difficult assembly operations required in the production of these parts and speed up the output, the Detroit Lubricator Co., Detroit, Mich., has developed unique tooling for several hydraulic presses. A production of from 1500 to 1700 thermostat components per hour is now possible with the assembly set-up described in the following.

Temperature-sensitive actuating elements of the thermostats are assembled in an air-conditioned room, where a cool temperature is constantly maintained. The first of the three assembly operations is compacting, or pelleting, of the power element, shown diagrammatically at the top in Fig. 1. This is performed on a 4-ton hydraulic press equipped with a six-station indexing table, made by the Denison Engineering Co., Columbus, Ohio.

A fixture at each station on the indexing table provides a close, slip fit for the copper cup of the thermostat power element. This snug fit prevents any expansion of the cup while the pellet is being compacted. The pressure required for compacting varies from 1000 to 4000 pounds, depending upon the size of the pellet. For one size thermostat, the copper cup has an inside diameter of 13/32 inch, and the pellet is 3/8 inch in diameter by 5/16 inch long.

When the operator has inserted a cup into one of the fixtures at the front of the table with one hand, and dropped an expansion pellet into the cup with the other hand, the pellet-loaded cup is automatically indexed under the press ram. The pellet is forced into the cup, under pressure of the ram-mounted tool, and compacted.

The distance from the top of the cup to the top of the compacted pellet is maintained within close tolerances. Ram speed is relatively slow to permit an even flow of the expansion material and to exclude all air from within the cup during compaction. A lift-cam under the indexing table causes the power element to be automatically ejected from the fixture as it is indexed past the ram.

Another Denison 4-ton hydraulic press is employed for the second operation of assembling the power element into the retaining ring shown in the center of Fig. 1. The retaining rings are dropped into place in the fixtures on the six-station indexing table, and the power elements are placed in the centers of the rings. A pressure of 2000 pounds is exerted by the ram to press and seat the power element solidly in the retainer. The pressed assemblies are removed from the fixtures by a lift-cam, as in the previous

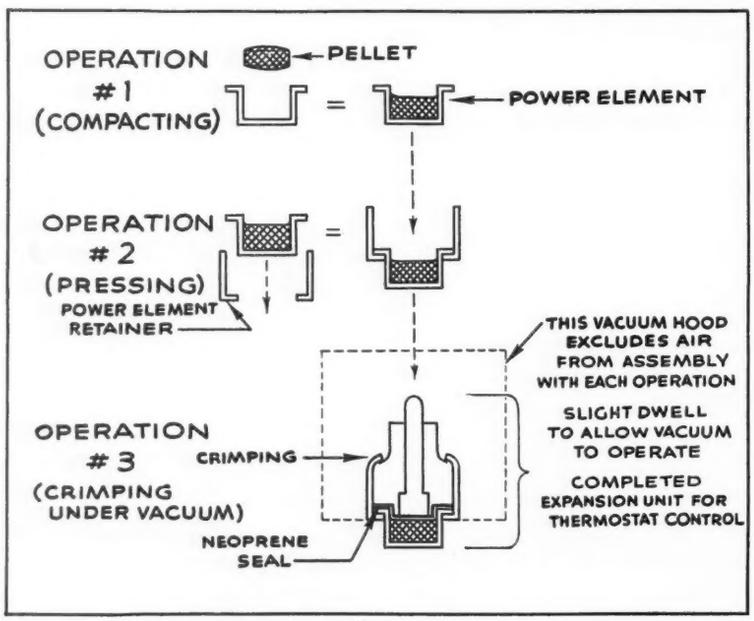


Fig. 1. Diagrammatic representation of the three operations required in assembling the temperature-sensitive actuating elements of water thermostats

Fig. 2. An air-tight chamber, formed by a housing on the press ram and the work-holding fixture, permits crimping of the thermostat assembly in a vacuum

operation, and a rod deflects the parts down a chute into a box for transfer to the next operation.

The 8-ton hydraulic press shown in Fig. 2 is employed for the third and final step in assembling the thermostat actuating elements. A unique tooling arrangement is employed to assemble the parts by crimping, evacuate air from the unit, and hermetically seal it in one operation. The assembled power element and retainer is placed in one of the fixtures at the front of the indexing table. A neoprene seal is then placed within the retainer, on top of the cup, and a piston guide is put on top of the seal, as seen at the bottom in Fig. 1. When the fixture has been indexed to a position below the press ram, the retainer ring is crimped around the piston guide.

It is essential that all air be exhausted from beneath the seal during crimping to insure accurate temperature control in the completed thermostat. This is accomplished by crimping in a vacuum. The peripheries of the work-holding fixtures are accurately ground, a smooth tapered surface being provided on their upper ends. A cylindrical housing is mounted on the press ram, around the crimping anvil, which fits over the fixture when the ram descends. The bore of the housing has a synthetic rubber ring in it which acts as an air seal between the fixture and the housing. A vacuum pump, connected to the housing, is operated by a cam-actuated valve as the ram descends. The ram dwells slightly to allow all the air to be evacuated before the assembly is crimped and sealed.

As the ram rises, the cam-operated valve closes the vacuum line, with no loss of vacuum. As in the previous two operations, the work is automatically lifted from the fixture and slides down a chute into a box.

* * *

In 1949, nearly 8,3000,000 net tons of foreign iron ore were brought into this country. That was an increase of 22 per cent over 1948, when imports totaled 6,800,000 tons. In 1947, about 5,492,000 tons were delivered, and in 1946, the imports totaled 3,085,000 tons.

Time-Study Booklet Distributed to SKF Employes

Wider employe understanding of time and motion study—a subject frequently the center of industrial controversy—is the aim of SKF Industries, Inc., Philadelphia, Pa., in preparing a booklet on this subject for distribution to workers in the plant.

The booklet explains time and motion study in simple language, and shows its importance in relation to the company's success. It points out how time studies help concerns to fix costs, so that they can successfully compete with other companies and keep people at work.

By eliminating unnecessary motions, reducing fatigue, utilizing mechanical means wherever possible, and generally making the worker's job easier, Americans have been able to do more for themselves than the people of any other nation.

* * *

An oil refinery was recently faced with the problem of moving a huge 3,800,000-gallon tank 1000 feet. Instead of using land vehicles to transport the tank, a trench 2 feet deep was dug with a bulldozer for the entire distance and filled with water from a nearby pond. The tank was then floated to its new location.

Generating a Square, Hexagon, or

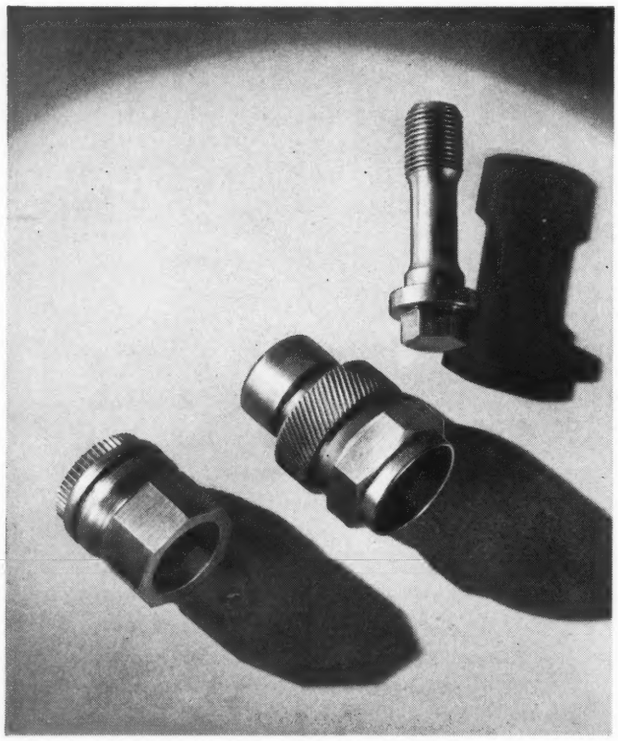


Fig. 1. Distributor cam with octagonal sides, spark plug body with hexagonal sides, and stud with hexagonal head generated on automatic screw machine

MANY parts are now being completely machined on multiple-spindle automatic screw machines with the aid of special attachments and tooling for such operations as cross-drilling, milling, and cutting worm threads. The milling of regular polygons with an even number of sides from round bar stock is an interesting special operation that can be performed on this type of machine. The distributor cam, spark plug body, and hexagonal-head shoulder stud shown in Fig. 1 are examples of work on which this operation has been performed.

It is the purpose of this article to develop the formulas required to design the attachment and cutter for this operation, which is remarkable for its simplicity in principle and accuracy of results. In this operation, two parts rotate in the same sense about parallel fixed axes. One part consists of an attachment which drives the milling cutter and the other is the work or bar stock being milled. The motions of the cutter and the work are simply related. The cutter rotates at twice the speed of the work and in the same direction. The cutting edge moves, at the point of contact, in a direction nearly opposite to that of the same point on the work.

The notable feature of the process is the accuracy with which the cut resulting from the combined motions approaches a straight line. This accuracy can be mathematically determined and the small deviations from perfectly flat sides on polygons of different numbers of sides readily computed.

In Fig. 2, two cutting teeth p and q rotate about the center c while the round stock rotates about the center w. The diameters of cutter and work and the center distance between them are such that the angle bcp is half the angle bwp. When the cutting edge of tooth p started to make the cut ap it was at b, which was then the position of point a on the work. When the tooth p had rotated through angle bcp, point a on the work had rotated through angle bwa.

If angle bcp equals $2A$, then bwa equals A, since the work turns at half the angular rate of the cutter. Also, angle bwp equals $4A$, as it is twice angle bcp. Hence, angle awp equals $5A$. In passing from b to p in Fig. 2, the cutter point is shown at five successive positions, b, 1, 2, 3, and p. In passing from b to a during the same interval of time, point a on the work occupies the five corresponding positions b, $1'$, $2'$, $3'$, and a. The positions on the work of the cutter point p as it moves from b to p are a, p_1, p_2, p_3, and p.

It can be seen from this, that path ap of the cutter tip along the work forms one side of the polygon and closely approximates a straight line. It can also be seen that $5A$ measures the angle spanned by one side of the polygon, when measured at the center of the work.

There must be half as many cutting teeth as sides on the polygon, so that this method excludes the cutting of polygons with an odd number of sides. In Fig. 2, two teeth p and q are shown, since a square is being cut. After the cutting tooth p emerges from the work, the opposite tooth q will rotate through 144 degrees and will arrive at b just as point p on the work, having turned through 72 degrees, arrives at the same point b. The tooth q will then start to cut the side pd of the square in the same manner as tooth p cut the side ap.

The four positions along line ap are located as follows: The points b, 1, 2, 3, and p are equally distant successive positions of the cutting tool, and angles $bc1$, $bc2$, $bc3$, and bcp are, respectively, the angles turned through by the cutting tooth to reach these positions. Now $bw1'$, $bw2'$, $bw3'$, and bwa are the corresponding angles turned through by the work. Angles $bw1$, $bw2$, $bw3$, and bwp are the corresponding angular dis-

Octagon on Automatic Screw Machines

By WILLIAM W. JOHNSON

placements of the tooth with respect to wb. Angles awp_1, awp_2, awp_3, and awp are, respectively, the sums of $bw1' + bw1$, $bw2' + bw2$, $bw3' + bw3$, and $bwa + bwp$. Point p_1 is located at the same radius as $w1$, p_2 at the same radius as $w2$, and p_3 at the same radius as $w3$.

In Fig. 3, the cutting tooth p is shown at p' after it has rotated through some angle $2B$ from the time of first contact with the work. During this period, the work has rotated about its center w through an angle B. Taking point w as the origin and wa as the x axis, the coordinates of the position of p' with respect to the x and y axes can be expressed as follows:

$$x = wa - bd = r_w \cos B - 2r_c \sin B \sin 3A$$

$$y = ab + dp' = r_w \sin B + 2r_c \sin B \cos 3A$$

in which r_w is the radius of the round stock and r_c the radius of the path of the cutting tooth tip.

Since $\dfrac{r_c}{r_w} = \dfrac{\sin 2A}{\sin A} = 2 \cos A$, these may be written:

$$x + 4r_w \sin B \cos A \sin 3A = r \cos B$$

$$y = r_w \sin B \ (1 + 4 \cos A \cos 3A)$$

If now we write k for $(1 + 4 \cos A \cos 3A)$ and tan G for $(4 \cos A \sin 3A)$, the xy equation can be written in the form:

$$k^2x^2 + 2k\,xy \tan G + y^2 \sec^2 G = k^2r_c^2$$

This is an ellipse with centers at the origin, major axis on the line $y + x \cot \dfrac{5A}{2} = 0$ and minor axis on the line $y = x \tan \dfrac{5A}{2}$.

The orientation of the ellipse with respect to the stock and cutter is shown in Fig. 4. One-half of the cut is that portion of the elliptic arc lying between the x axis and the line $y = x \tan \dfrac{5A}{2}$. This arc segment is symmetrical with the minor axis, so that the maximum deviation of cut v (not shown in Fig. 4 because of its minute length) from a straight line will be $v = m - r_w \cos \dfrac{5A}{2}$ in which $2m$ is the length of the minor axis of the ellipse.

It can be shown that the length m of one-half the minor axis can be found by the equation:

$$m = r_w \frac{1 + 4 \cos A \cos 3A}{1 + 4 \cos \dfrac{A}{2} \cos \dfrac{3A}{2}}$$

Thus, knowing m, r_w, and A, the maximum deviation v of the elliptic arc from a straight line

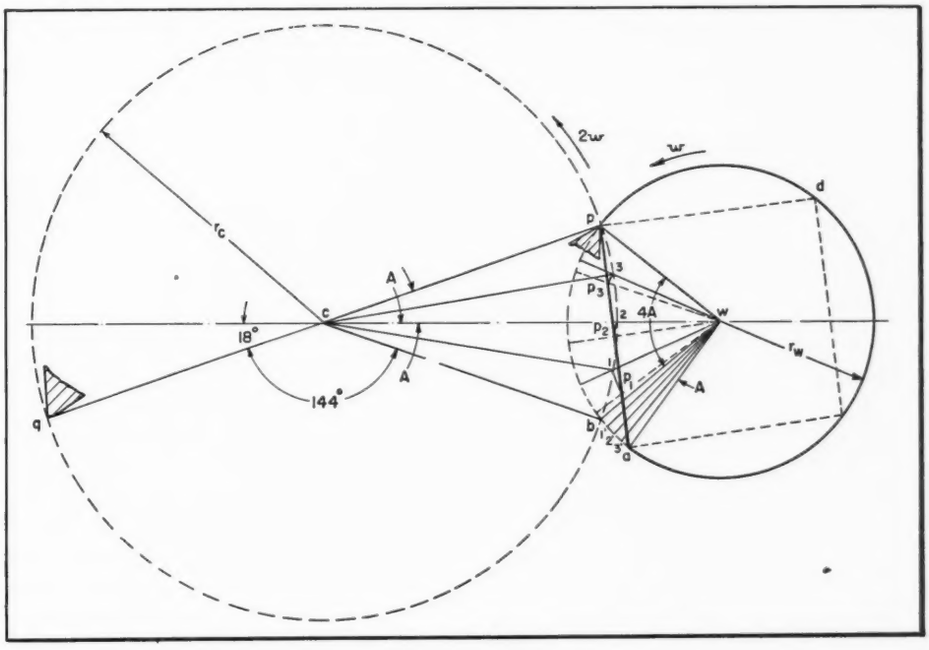


Fig. 2. Diagram showing how side (ap) of a square is generated by passage of cutter tooth (p) across work

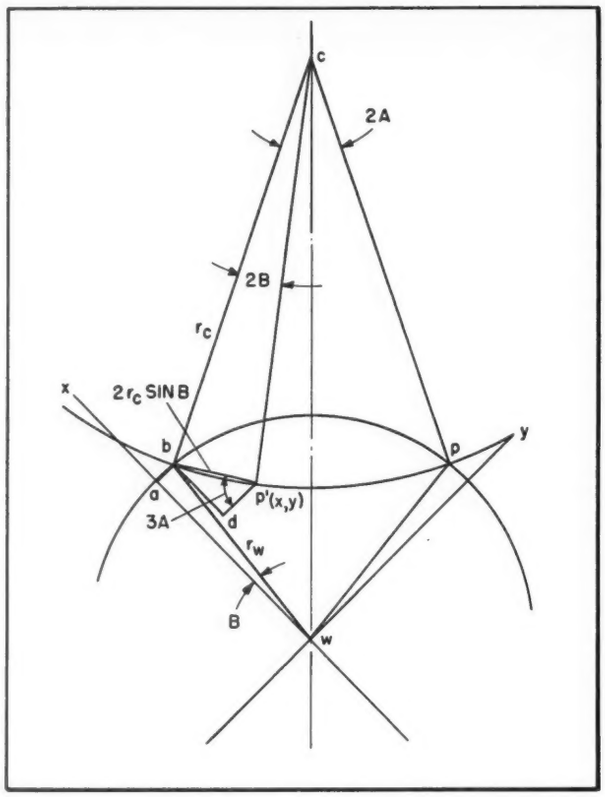
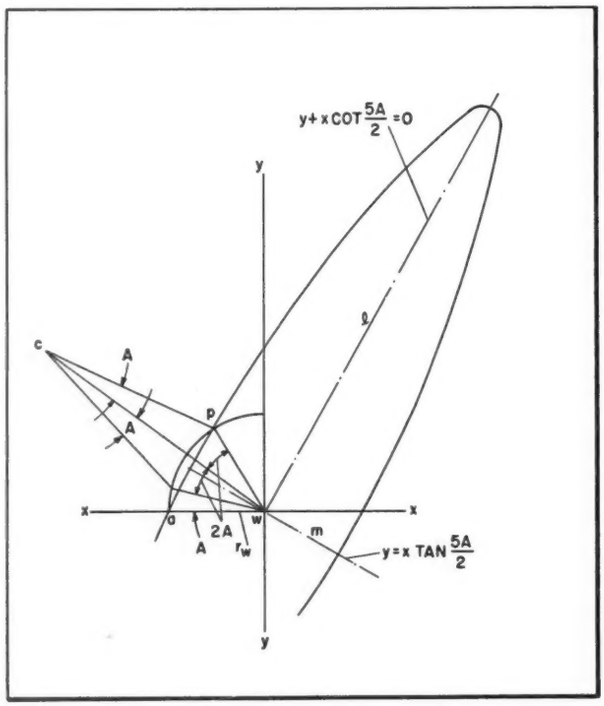


Fig. 3. Diagram for establishing position (p') of cutter tooth with relation to arbitrary (x) and (y) axes drawn as shown

Fig. 4. The path (ap) of the cutter tooth across the work is part of an ellipse having axes as shown in the diagram



can be found. For a square cut from stock of 1-inch radius, v is 0.0088 inch; for a hexagon cut from the same size stock, v is 0.0048 inch; and for an octagon cut, 0.0028 inch.

Fig. 5 shows the position of the related ellipse with respect to a square and a hexagon. It will be seen that, in each case, the side of the figure being cut is located on that part of the elliptic arc which has the least curvature.

In order to cut a polygon of n sides (n must always be an even number), having a width t as measured across opposite sides or flats, the radius r_w of the stock, the radius r_c of the cutter, and the center distance s between them must be found.

Referring to Fig. 6, it will be seen that if

$$fw = \frac{t}{2} \text{ and angle } pwa = 5A$$

$$r_w \cos \frac{5A}{2} = \frac{t}{2}$$

or

$$r_w = \frac{t}{2} \sec \frac{5A}{2} \qquad (1)$$

where

$$5A = \frac{360 \text{ deg.}}{n}$$

It can also be seen from triangle cpw in Fig. 6 that according to the law of sines:

$$r_c = r_w \frac{\sin 2A}{\sin A}$$

or

$$r_c = r_w \frac{2 \sin A \cos A}{\sin A} = 2r_w \cos A \qquad (2)$$

where

$$A = \frac{72 \text{ deg.}}{n}$$

Also

$$s = r_w \frac{\sin (180 \text{ deg.} - 3A)}{\sin A} \qquad (3)$$

or

$$s = r_w \frac{\sin 3A}{\sin A}$$

where

$$3A = \frac{216 \text{ deg.}}{n}$$

Example—Find the radius r_w of stock, radius r_c of cutter, and center distance s between them for cutting a hexagon, the measurement t across the flats of which is to be 0.625 inch.

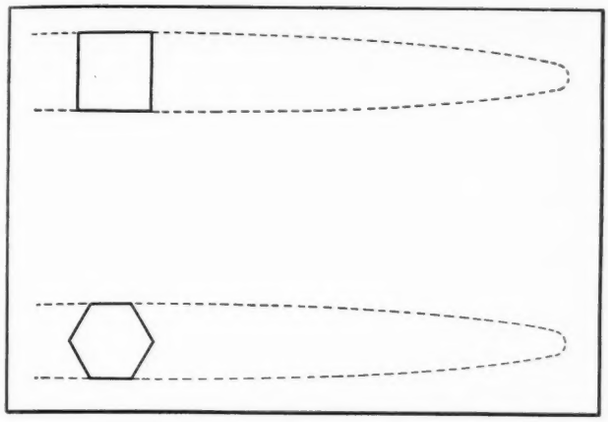


Fig. 5. The generated side of the polygon, whether square, hexagon, etc., is located along the flattest portion of the ellipse as shown

Solution—If $t = 0.625$ and $n = 6$, then

$$r_w = \frac{0.625}{2} \sec \frac{180 \text{ deg.}}{6}$$

$$r_w = 0.3125 \sec 30 \text{ degrees}$$

$$r_w = 0.3125 \times 1.1547 = 0.3608 \text{ inch}$$

and

$$r_c = 2 \times 0.3608 \cos \frac{72 \text{ deg.}}{6}$$

$$r_c = 0.7216 \cos 12 \text{ degrees}$$

$$r_c = 0.7216 \times 0.97815 = 0.7058 \text{ inch}$$

$$s = 0.3608 \frac{\sin 36 \text{ deg.}}{\sin 12 \text{ deg.}}$$

$$s = 0.3608 \frac{0.58778}{0.20791}$$

$$s = 1.020 \text{ inches}$$

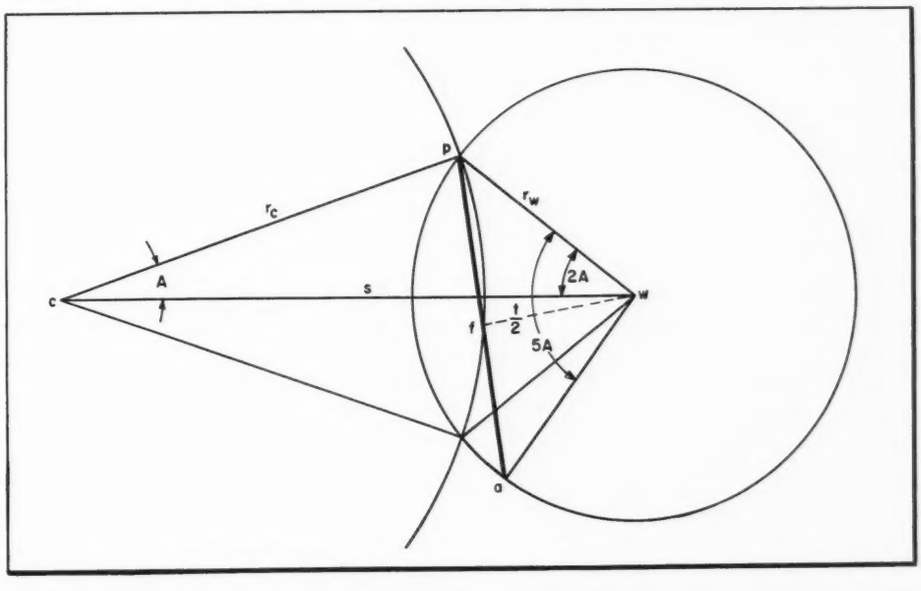
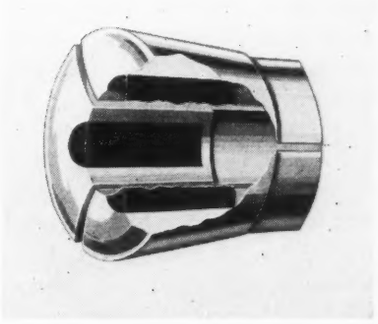


Fig. 6. Diagram showing relation of distance (t) across flats of polygon to radius (r_c) of cutter, radius (r_w) of work, and center distance (s)

Tungsten-Carbide Inserts Used in Salvaging Worn Collets

A new method of restoring collets and feed-fingers that have been worn over size through long use has been announced by S & E Machine Products, Inc., Bridgeport, Mich. With this process, tungsten-carbide inserts are applied to the worn collets and ground down to the original collet dimensions.

This salvaging process is especially adapted for collets employed in high-speed automatic machines or similar equipment where accuracy must be maintained on long-run jobs with a minimum of "down time." Collets reclaimed by the new method are said by users to have fifty times the life of the original steel collets. The illustration shows a collet after the application of the tungsten-carbide inserts.



Worn collet that has been reclaimed by the application of tungsten - carbide inserts

* * *

Of the 1871 firms manufacturing motor vehicles, parts, and accessories in the United States, 30 per cent have less than 8 employes and 75 per cent have less than 100 employes.

Materials of Industry

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Quick-Acting Compound for Casehardening Steel

The Miracaloy Corporation, 50 Broadway, New York 4, N. Y., has announced the development of a low-cost quick-acting steel hardening compound known as "Hard-N-Deep." Under the action of heat, it is said to quickly penetrate the surface of the part being treated, and produces a carburizing, nitriding, and chromizing action, the result being a tough, uniform case without appreciable change in surface dimensions. The part to be hardened is heated to a cherry red, dipped in the compound, brought back to temperature, and quenched. Deeper case penetration can be obtained by repeating the process... M-201

High-Temperature Lubricating Oil for Conveyor and Oven Bearings

Bearings and chains that are continuously subjected to severe operating temperatures can be effectively lubricated by a carbon-free, high-temperature lubricating oil made by the Swan-Finch Oil Corporation, New York. Safco No. 1250 "Hi-Temp" oil, as the new lubricant is called, is suitable for the lubrication of conveyor bearings, core-oven bearings, and textile-mill oven bearings and chains.

It is claimed that, when properly applied, the oil will "stay put" and lubricate hot bearing surfaces, prevent carbon deposits, and keep chains and bearings clean. M-202

Heat-Resistant Silicone-Glass Molding Compound

A molding compound consisting of a silicone resin and a glass fiber filler has recently been developed by the General Electric Co., Pittsfied, Mass. The properties of the new compound, designated G-E 12810, include high resistance to heat, impact, and arcing, as well as good flow in the mold, making it suitable for circuit-breakers, switch-gear, and other parts subjected to extreme heat and impact. M-203

B & S Ground Flat Stock Hardenable in Oil or Water

The Brown & Sharpe Mfg. Co., Providence, R. I., has announced the availability of ground flat stock for hardening in oil, as well as water. Sixteen thicknesses in widths up to 6 inches, all 18 inches long, are obtainable. Stock under 3/16 inch thick is hardenable in oil or water, while stock above 7/32 inch thick is made in two types —hardenable in oil only or hardenable in water only. M-204

Corrosion-Resistant Coating Adherent to Smooth Surfaces

A corrosion-resistant vinyl resin has been developed to meet a wide range of surfacing requirements by the Dampney Co. of America, Hyde Park, Boston 36, Mass. This material can be modified to suit individual needs. It is recommended for service over an operating temperature range of —40 degrees F. to 160 degrees F., wet or dry. The new coating is resistant to alkalies and mineral acids, is insoluble in alcohols, greases, oils, and aliphatic hydrocarbons, and has low permeability to water vapor.

Excellent adhesion to relatively smooth surfaces without heat curing is claimed for this coating, as compared with previously available vinyl resin base materials. The surface is durable, as well as decorative, and is obtainable in clear, black, or gray high-gloss finish, or other colors as required. Application may be made by either brushing or spraying. M-205

Notched-Coil Silver Brazing Rings Reduce Assembly Time

Silver brazing and soldering rings furnished in notched-coil form have been announced by the Lucas-Milhaupt Engineering Co., 5057 South Lake Drive, Cudahy, Wis. The notched-coil arrangement enables the rings to be quickly and easily detached, thus facilitating the brazing and soldering operations and reducing assembly time.

To obtain additional information about materials described here, use Inquiry Card on page 225.

A measured amount of the silver alloy is used in the rings, thus decreasing costs by saving material. A stress relieving treatment prevents the rings from creeping or becoming distorted when heat is applied. The new line includes rings, the ends of which automatically lap over each other when the rings are detached from the notched coil and snapped over the periphery of parts to be brazed. M-206

Drawing Compound that Leaves No Stain

A drawing compound known as "Fluid-Film" that maintains its physical properties during repeated stamping of ferrous and non-ferrous alloys has been placed on the market by the Northwest Chemical Co., 9310 Roselawn Ave., Detroit 4, Mich. It is said to be unaffected by atmospheric conditions, and can be applied by brushing, spraying, rolling, or dipping. The film produced leaves no stain on the surface of any alloy after removal with hot water or an alkaline cleaner. M-207

Strippable Coatings for Protecting Tools and Plastic Surfaces

Fidelity Chemical Products Corporation, 470 Frelinghuysen Ave., Newark 5, N. J., has announced two new products—"Strippable Coating SP-14" for enameled, lacquered, and plastic surfaces, and "Dip-Pak No. 532," a hot-melt coating for metal parts such as tools, gears, and machined parts. Both of these products serve as temporary protection during processing, storage, and shipment. It is said that "SP-14" will not affect the color or finish of any part to which it is applied, and when dry, the film is non-inflammable, abrasive-resistant, and strongly adherent.

"Dip-Pak No. 532" provides temporary protection for precision tools and machined parts during both storage and shipping. When applied to a metal object, it produces a transparent abrasive- and rust-resistant skin, which can be removed by slitting and peeling off. M-208

Casting Compound that Pours at Room Temperature

A new casting compound, "Plasti-Metl," that is neither a metal nor a plastic has been developed by the Plastics Division of the Lockrey Co., College Point, N. Y. The compound is copper-colored, harder than some casting metals, yet can be poured into molds at room temperature. It can be made to set without heat, forming a hard, tough, metallic appearing casting that can be machined or polished with ordinary tools.

The new casting compound is a thermosetting material which cannot be softened by heat once it is set, and has resistance to all common chemicals except strong alkalis. It can be poured into rubber, plastic, metal, or clay molds with or without inserts, or it can be slush-molded. The compound can be used to cast forming molds and machine replacement parts. M-209

Wear-resistant parts, embossing dies, and trademark stamps hard-faced with cemented carbide by the Carboloy Company

Unusual Work- for Textile

By PAUL E. BRUCHON
Hunt Machine Works, Inc.
Greenville, S. C.

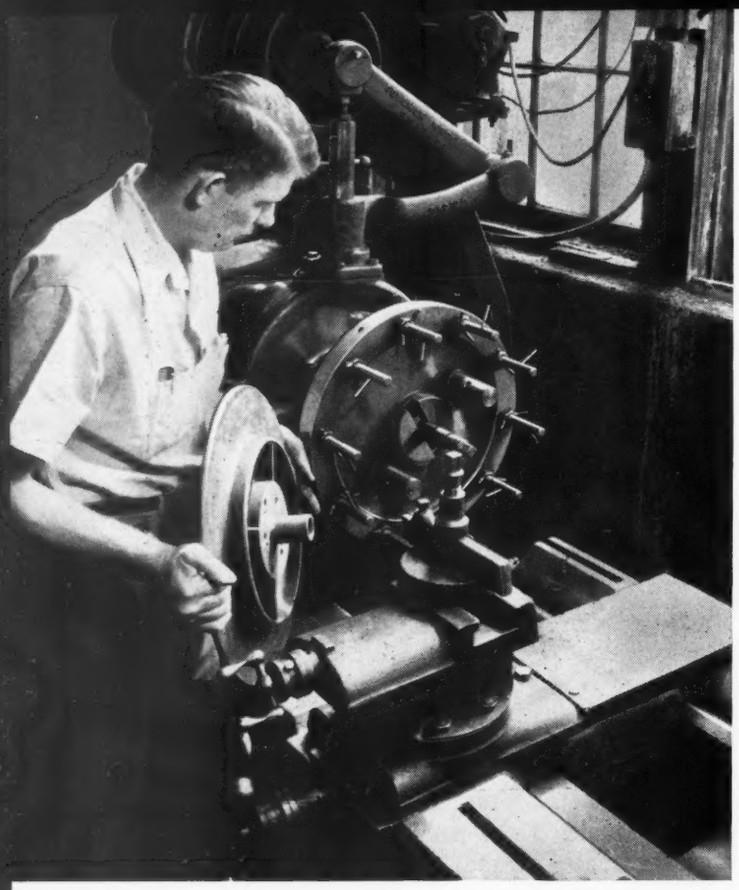


Fig. 1. Special spider faceplate, mounted on the spindle nose of an engine lathe, is employed to hold thin cast-iron beam heads during turning and facing operations to eliminate distortion

TEXTILE looms are complex mechanisms, requiring the manufacture of numerous parts of various size and shape. To attain the present production capacity of 500 looms a month, the Hunt Machine Works has developed many ingenious work-holding fixtures. Some of the more unique of these are described here.

Rayon beam heads, such as the one seen in the operator's hands in Fig. 1, are thin iron castings that must be machined to a fine surface finish and must have the faces of the part parallel to each other and at right angles to the bore within close tolerances. To eliminate the distortion encountered in clamping this thin casting in a three-jaw chuck, a special spider faceplate, seen mounted on the spindle nose of a Sidney lathe in the illustration was designed.

This combination driving adapter and holding fixture consists of a faceplate with ten projecting support fingers. The faceplate has an internally threaded hub that is screwed on the spindle nose of the lathe, and projecting from the opposite side, an expanding mandrel on which the work is centrally located. The support fingers, which are threaded into the faceplate, can be used as jack-screws to adjust the position of the work until its face runs true.

In a previous operation, the beam-head casting is bored and reamed on a turret lathe. In the operation shown, the part is turned and faced. About 3/32 inch of stock is removed from the surfaces of the casting with the work rotating at 250 surface feet per minute while the tool is fed at 0.031 inch per revolution. From 0.020 to 0.030 inch of stock is left on the outer face of the part for removal in a subsequent grinding operation.

A similar fixture, with the internally threaded hub omitted, is employed in surface grinding the beam heads. The fixtures are held on the cir-

Fig. 2. Rocker jaws, pinned to the regular jaws of the chuck on a turret lathe, provide six-position clamping of the thin-walled ring gear blank to minimize distortion during boring

Holding Fixtures Loom Parts

cular magnetic chuck of a Blanchard surface grinding machine. As is the case in the turning and facing operation, the work is centrally located on the expanding mandrel of the fixture, and the jack-screws are raised or lowered to make the face of the casting parallel to the face of the grinding wheel. Thus any distortion caused by scale removal is compensated for and a smooth surface finish is obtained.

Another method of minimizing work distortion in chucking fragile parts is illustrated in Fig. 2. Here three rocker jaws are pinned to the regular jaws of the chuck on a Warner & Swasey turret lathe. The rocker jaws are free to pivot about the pins, and provide six-position clamping instead of the three-position clamping obtained with a three-jaw chuck.

The thin-walled casting shown is a friction-drive ring gear blank for a textile loom. The work is bored and faced in this operation. Similar rocker jaws are provided to clamp the bore of the part for turning and facing the casting. In both of these applications, pressure is applied to the work at locations only 60 degrees apart, instead of 120 degrees apart as in conventional three-jaw chucks.

A cork-faced driving adapter, seen mounted in the chuck of a turret lathe in Fig. 3, is used to rotate a thin cast-iron friction disk while turning and facing the hub and facing the locating ring. The outside diameter of the disk hub must be machined concentric with the bore, and the locating ring on one side of the part must be held parallel to the opposite side, within close dimensional limits. One side of the friction disk is faced with cork following this machining operation.

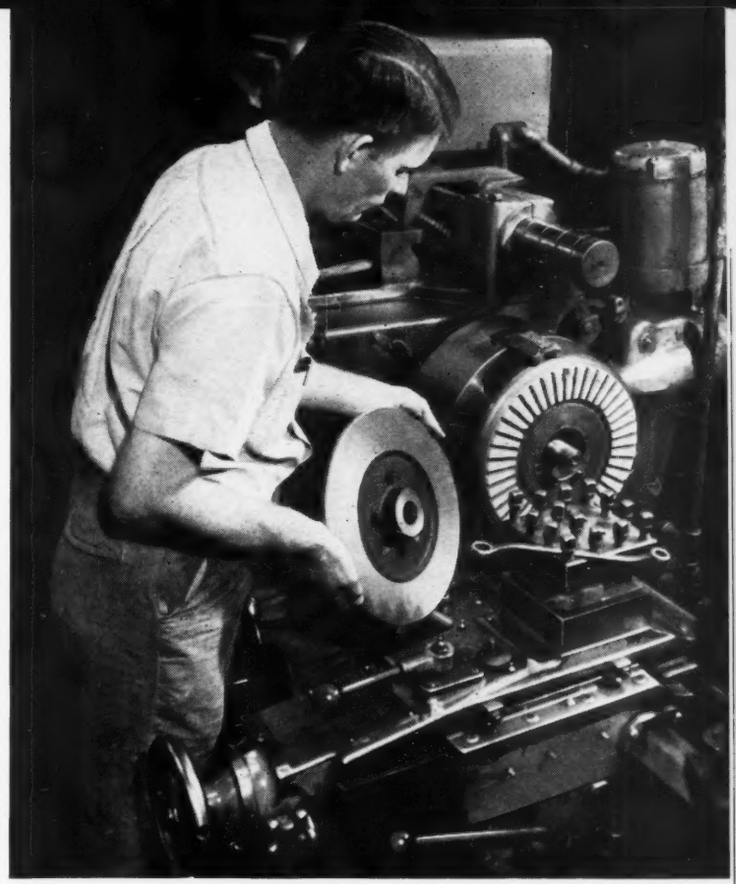


Fig. 3. A thin cast-iron friction disk, seen in the operator's hands, is rotated and accurately located by means of the cork-faced driving adapter mounted on the spindle of the turret lathe

The driving adapter consists of a cast-iron blank having a centrally located pin for accurately positioning the work. A radially grooved cork ring, the same as those applied to the friction disks after machining, is cemented to the face of the driving adapter blank. A tapped hole in the end of the pin permits the use of a split

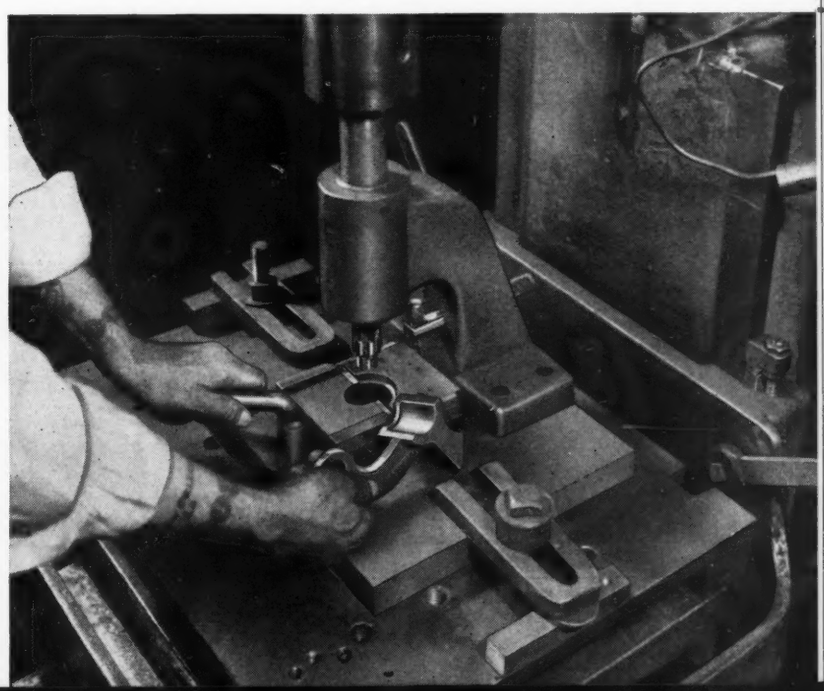


Fig. 4. A bronze bearing, 5 inches long, in the overhead arm of this fixture prevents the side pressure created in milling a half-bore from forcing the tool away from the work

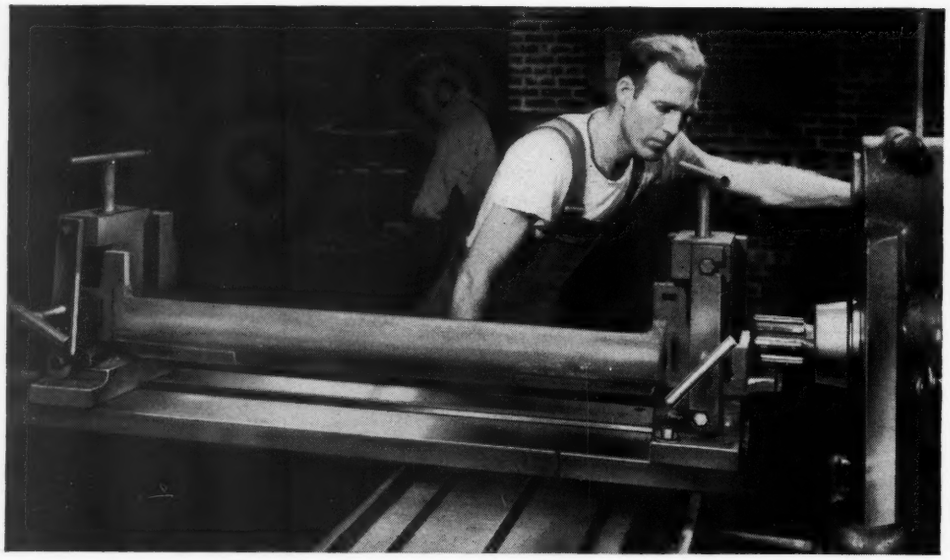


Fig. 5. Improvised set-up for milling both ends of long cast-iron breast beams for textile looms. Parallelism of the milled surfaces is insured by locating the fixtures from a rib on the baseplate

washer and cap-screw to draw the part to be machined against the driving adapter. Sufficient friction is thus created between the cork and one face of the cast-iron disk to rotate the disk during machining.

Replacement beam-lock bearing caps are frequently ordered for textile looms, making it impossible to bore the assembled beam-lock and cap. Finishing of the half-bore in the bearing cap is facilitated by means of the fixture seen in Fig. 4. The operation is performed on a Cincinnati-Bickford upright drilling machine, using a double-diameter, carbide-tipped end-mill. The cast-iron cap to be machined is held between a split plate on the base of the fixture. The front half of the plate is a cam-actuated, spring-returned slide that is guided by ways extending along both sides of the plate.

A bronze bearing, 5 inches long, provided in the overhead arm of the fixture guides the spindle of the machine and prevents the side cutting pressure from forcing the tool away from the work. The two diameters, 1 1/4 and 1 1/8 inches, are both machined in one operation, removing about 3/32 inch of stock from each. The tool is rotated at a surface speed of 200 feet per minute and power fed at 0.020 inch per revolution.

Both ends of the long cast-iron breast beams must be machined for fitting to the sides of the textile looms. Since a wide-bed, double-head milling machine was unavailable, the set-up shown in Fig. 5 was improvised. A heavy ribbed plate was mounted on the table of a Brown & Sharpe milling machine. Two fixtures, slotted to fit the rib on the baseplate, hold the workpiece. The position of the fixtures on the plate can be changed to accommodate different sized beams.

When one end of the beam has been milled, the fixtures are slid off the baseplate, rotated through an angle of 180 degrees, and repositioned on the rib of the baseplate for machining the opposite end of the beam. In this way, parallelism of the milled surfaces on opposite ends of the beam is insured, since the position of the work in the fixtures is not changed.

A carbide-tipped end-mill, 4 inches in diameter with six teeth, is employed. The cutter is rotated at 250 surface feet per minute, and the milling machine table is fed past the cutter at the rate of 0.015 inch per revolution. Approximately 1/8 inch of stock is milled from each surface.

* * *

Five New Machining Films Produced by Monarch Machine Tool Co.

Five new motion pictures dramatically depicting the cost reducing advantages and special design features of the turning equipment made by the Monarch Machine Tool Co., Sidney, Ohio, have recently been brought out. One of the films shows a variety of typical job applications of the Air-Gage Tracer in contour turning, facing, and boring on Monarch engine lathes. Another film in the series presents the "Speedi-Matic," an electronically controlled high-production precision hand screw machine. The third film shows examples of ultra-precision turning, boring, and facing in the tool-room, and the last two depict numerous representative, diversified turning operations being performed with the Monarch "Mona-Matic" lathe.

These sound films are available without obligation for showing to trade and industrial groups, manufacturers, production engineers, tool supervisors and superintendents, master mechanics, plant and works managers, etc.

Tool Engineering Ideas

Tools and Fixtures of Unusual Design, and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

Shock-Testing Fixture for Determining Life of Products

By FRANK J. PERAGINE, South Hempstead, N. Y.

Products such as instruments, clocks, gages, electronic tubes, etc., that are to be subjected to shock during ordinary usage can be tested to determine their expected life span by means of the simple fixture here illustrated. The product to be tested is elevated by a cam-actuated lift-rod and lowered by the action of rebound springs. The number of "thumps" per minute can be varied, and the distance the product is raised can be adjusted to simulate the shock to which it will be subjected in use.

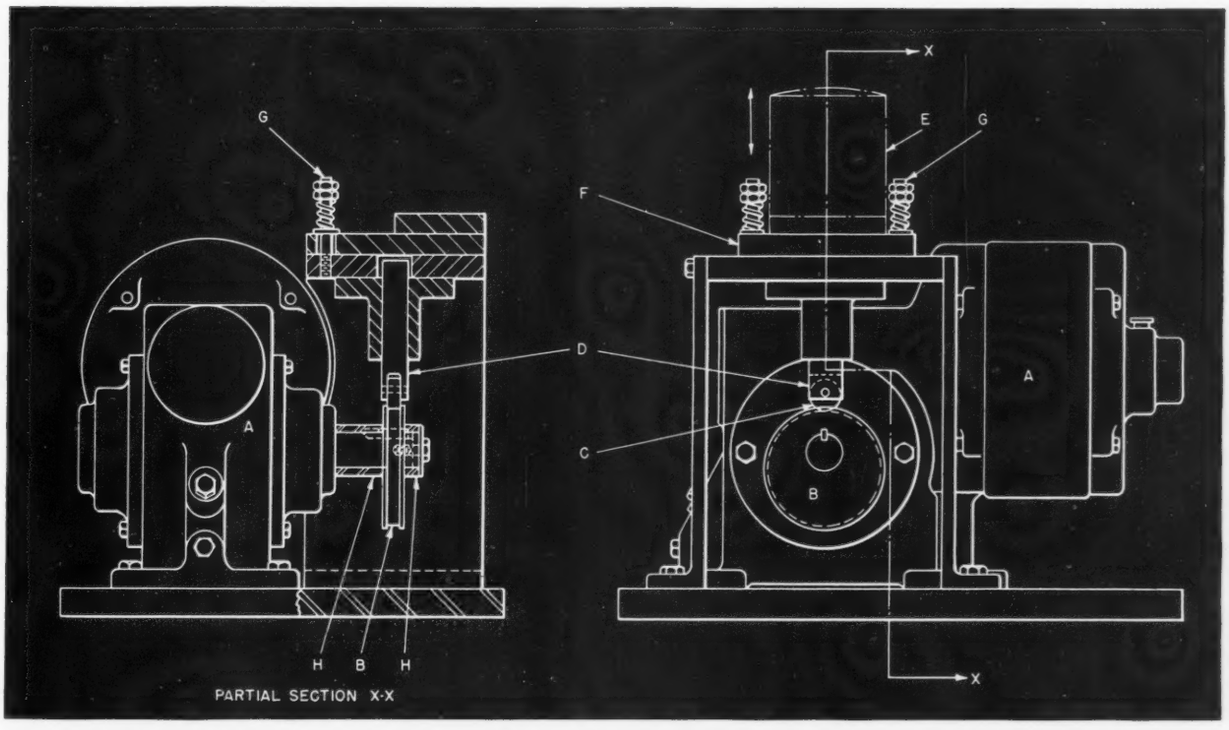
In the set-up shown, a 1/4-H.P. gear-reduction motor *A* is employed to rotate cam *B* at 96 R.P.M. Roller *C*, pinned to the lower end of lift-rod *D*, contacts the periphery of the cam, thus jiggling the product *E* under test ninety-six times per minute. The part to be tested is mounted on a suitable adapter plate *F*, which serves as a wear surface for the lift-rod and guides the part in its vertical travel by means of studs *G*. Springs mounted on these studs rapidly return the part to the position shown after each elevation.

Compactness, safety, and accessibility are features of this low-cost fixture. Various cams and adapter plates can be designed to accommodate different products and to alter the rate of reciprocation. More than one cam may be employed, if necessary, to lift heavy parts. The axial location of the cam can be adjusted by changing spacers *H*.

Fixture for Machining a Fragile Part

By ROBERT MAWSON, Providence, R. I.

Fixtures employed in machining operations should hold the work-piece securely to prevent



Simple shock-testing fixture which emp'oys a gear-reduction motor (A) to drive cam (B). The rate at which product (E) is raised and lowered, as well as the distance, can be varied to suit requirements

distortion. This is especially important if the piece being machined is fragile. If there is a possibility that the shape of the piece will be changed by the holding method during the machining operation, interchangeable products will not be produced. To comply with the principles of good tool design, the fixture should support the work as near as possible to the surface being machined, and also on its strongest section.

The fragile part seen at the lower right in Fig. 1, which is employed as a thread guide on textile machines, is stamped from sheet steel only 0.078 inch thick. It is necessary to machine the two projections on the left-hand end of the part to close tolerances and an included angle of 120 degrees. The outer edges of the projections are subsequently machined to an included angle of 30 degrees to produce the shape shown in the detail views of the work. The part can be quickly and accurately located and rigidly held during machining by means of the fixture shown.

Hardened tool-steel plugs *A* are driven into holes reamed in the sixteen projecting feet on the cast-iron body *B* of the fixture. The projecting ends of these plugs are ground either parallel or at right angles to each other. Tool guide bushings *C* and *D* are provided in opposite faces of the fixture body. A projection machined on the inner edge of bushing *D* is used as one of the locating surfaces for the work-piece. A tool-steel block *E*, the top surface of which is machined to fit the contour of the stamping, is secured to the base of the fixture by means of screws and dowel-pins. A locating pin *F* is also fastened to a pad cast on one side of the body.

A hardened tool-steel push-pin *G* is provided in the opposite wall of the base. The push-pin is backed up by a tension spring that is held in the fixture by means of a headless set-screw *H*. When the pin has made contact with the work-piece, it is held in position by the knurled head screw *J*.

Cover *K* fits between finished surfaces on the fixture body, pivoting about a hinge-pin as it is moved into or out of the machining position by means of handle *L*. This handle is provided with a cam surface which contacts pin *M*, fastened in the fixture body, to hold the cover in position while the part is being machined. A section on the under side of the cover is machined to the contour of the work-piece, thus serving as one of the locating surfaces.

A hardened and ground, high-speed steel facing bar *A*, Fig. 2, is employed as the tool. The left-hand end of the tool is machined to fit the

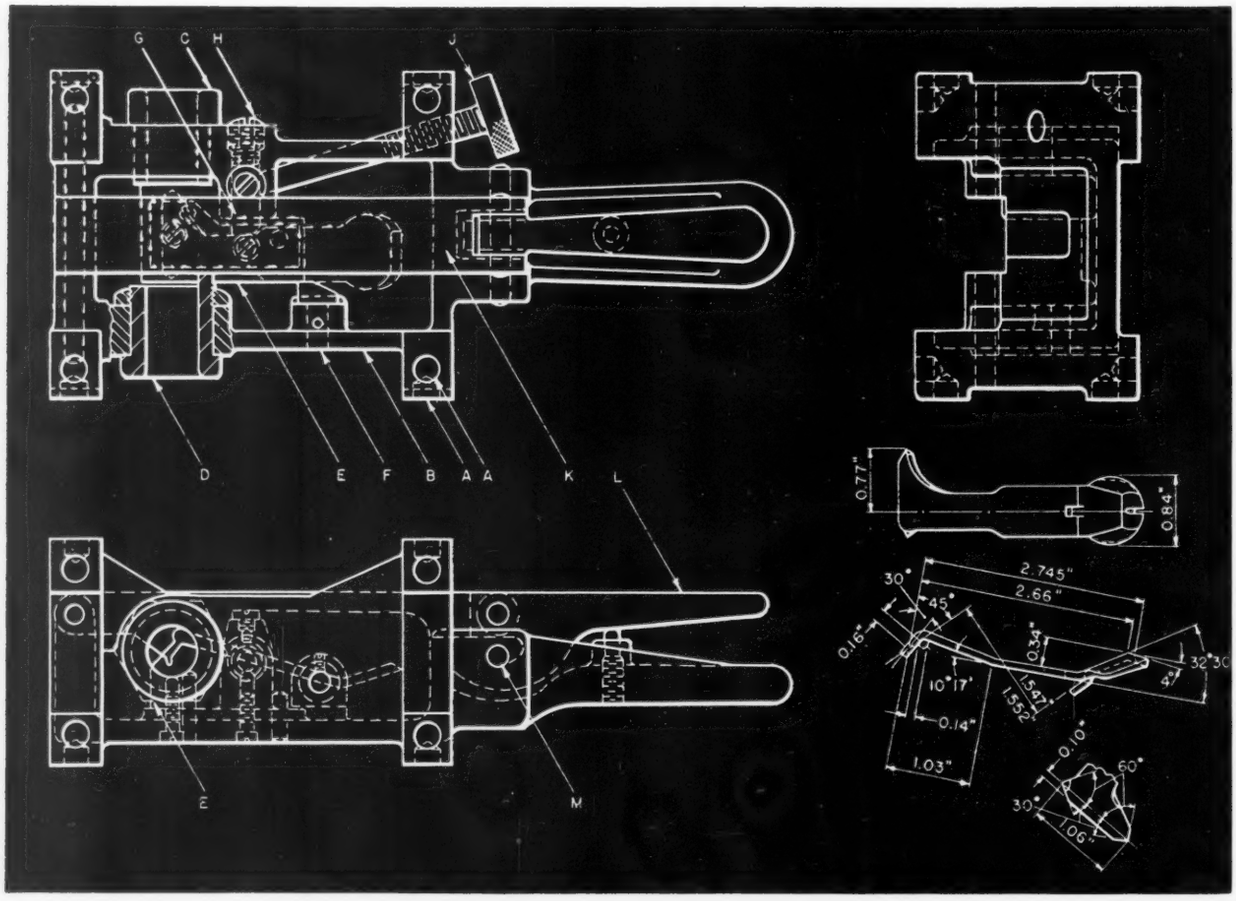


Fig. 1. Fixture for machining the two projections on the left-hand end of the sheet-metal stamping seen at the lower right

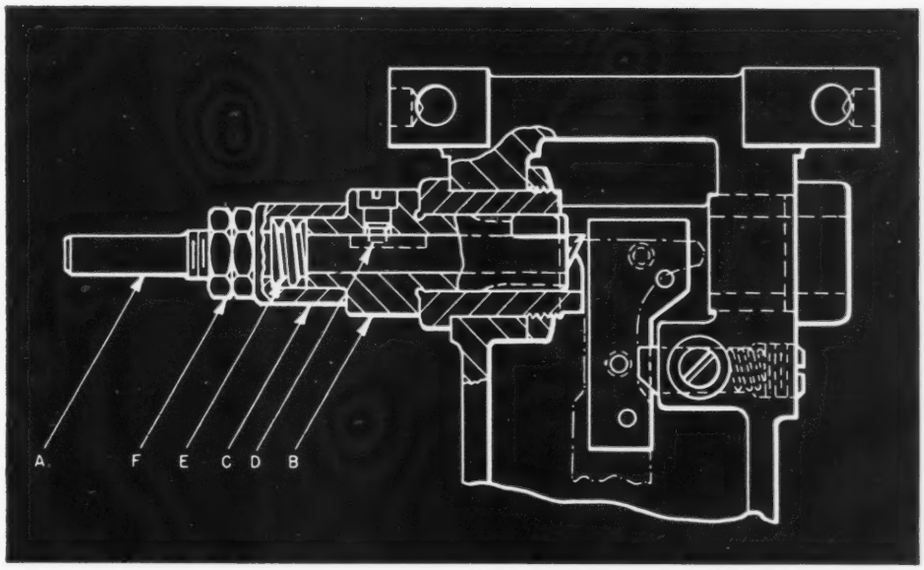


Fig. 2. Tool employed to machine textile machine thread guides. Bar (A) is automatically withdrawn from the work at the completion of the cut by means of compression spring (E)

spindle of a milling machine, while the opposite end is ground to the correct angle, with undercut, to form the desired 60-degree angle on the work-piece. Tool support *B* is also made from hardened and ground tool steel. The right-hand end of the support is cylindrically ground to a good sliding fit within the tool guide bushings mounted in the fixture. The left-hand end of the support is similarly ground to slide within spring housing *C*.

Support *B* rotates with bar *A*, the torque being transmitted through a fillister-head screw *D*. The lower end of the screw fits into a groove machined in bar *A*, permitting the bar to be automatically withdrawn from the work at the completion of the cut by the action of compression spring *E* on support *B* and housing *C*. This prevents the tool from making chatter marks on the machined surfaces. After proper adjustment of the tool, bar *A* is secured to housing *C* by means of the two nuts *F*.

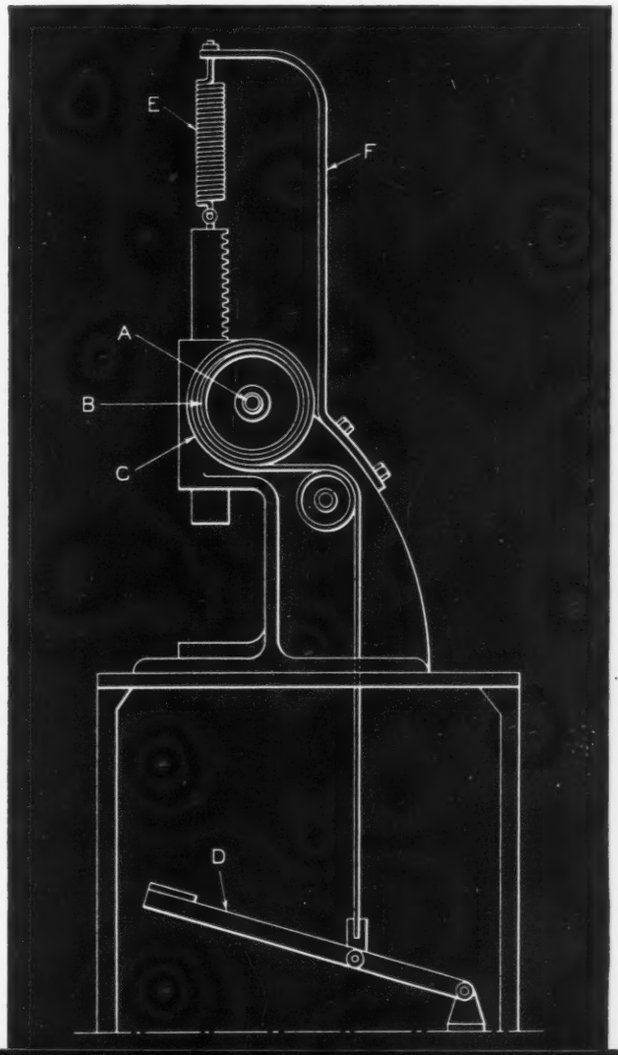
In use, the fixture is held on a sub-base, mounted on the milling machine table, which permits the fixture to be indexed through an angle of 180 degrees. At the completion of the cuts, it is only necessary to retract the milling machine table, loosen screw *J* (Fig. 1), swing back cover *K* by means of handle *L*, and remove the finished piece from the fixture.

Arbor Press Arrangement for Light Broaching Operations

By EDWIN MOSTHAF, Industrial Consultant
Huntington, W. Va.

Light broaching, required for occasional jobs in small machine shops or for die work in toolrooms, sometimes presents a problem because of the need for long continuous strokes of the tool. Generally, broaching machines are not available for work of this type because of the small number of parts required. As a result, drill or arbor presses are often used, although the strokes obtained are interrupted and short due to the diffi-

Arbor press equipped with foot-operated treadle for light broaching operations



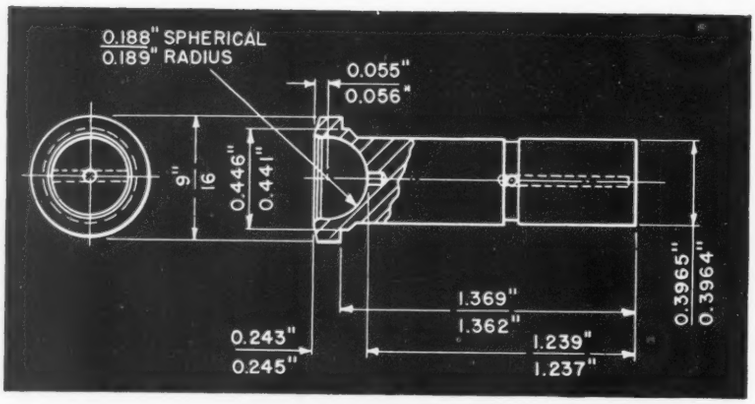


Fig. 1. Piston for a high-pressure airplane pump. Right-hand ends of the pistons are accurately ground, twenty at a time, by means of the fixture shown in Fig. 2

culty of revolving a handwheel or lever continuously. A means of overcoming these difficulties by providing an arbor press with a smooth broaching stroke is shown in the accompanying illustration.

The pinion shaft *A* is provided with a flat pulley *B*, around which is wrapped a flat belt *C*. The belting may be wound around the periphery of the pulley two or three times, depending upon the length of stroke required. The pulley is actuated by a long-stroke foot-lever *D*, to which the lower end of the belt is fastened. A spring *E*, connected to a bracket *F*, is attached to the ram to provide a means of returning the ram to its normal position and to rewind the belt around the pulley after a stroke has been completed. This arrangement considerably facilitates short-run broaching operations and does not require expensive equipment.

Fixture Designed for Accurate Grinding of Piston Ends

By ROBERT W. NEWTON
Watertown, N. Y.

High-pressure pumps for airplanes require the precision manufacture of many close-tolerance parts. To produce such parts on a mass-production basis, simple, quick-acting, and accurate work-holding fixtures had to be developed. Nine of the pistons shown in Fig. 1 are required for one type of pump, and the manufacturer had to produce 1000 pumps a month.

The right-hand end of the piston had to be ground flat, square with the center line of the piston, and with a dimensional tolerance of only $\pm$ 0.001 inch from the bottom of the spherical seat in the opposite end of the piston. Several different fixtures were tried in finishing this surface on rotary and surface grinding machines, with unsatisfactory results. Either the clamping action was too slow or the method of loading was inaccurate. Finally, the fixture shown in Fig. 2 was developed; this has been used successfully for several years in grinding the end surface of the piston shown and several others of different sizes.

The pistons are placed in the fixture vertically, twenty at a time, with their spherical seats resting on pins *A* and the ends to be ground projecting upward above the fixture. By rotating one hand-knob *B*, all of the pistons on both sides of

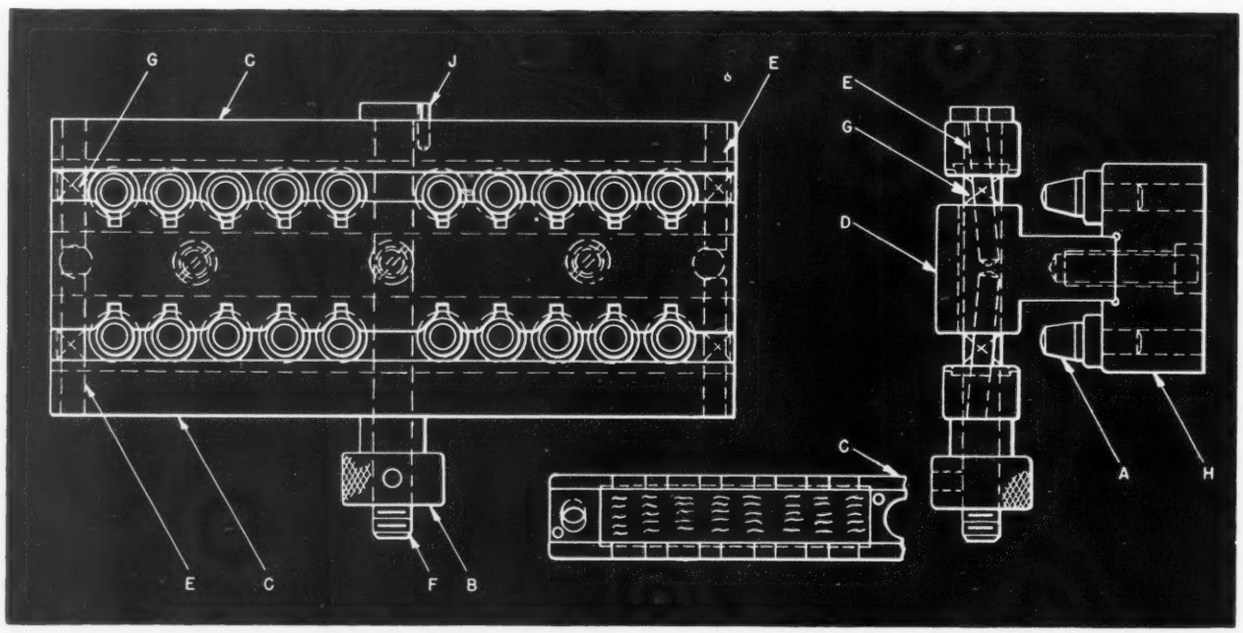
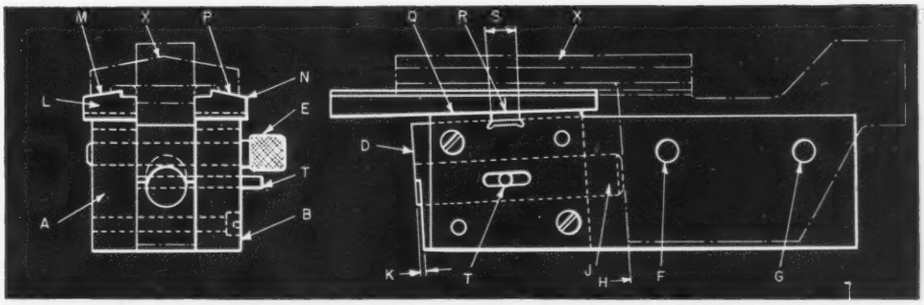


Fig. 2. Work-holding fixture employed for surface grinding the ends of pump pistons. Twenty of the pistons are securely clamped by simply rotating hand-knob (B)



Gage that utilizes a flush-pin combined with wedges to inspect the relationship between various angular surfaces on part (X) and holes at (F) and (G) in the part

the fixture are clamped at once between bars *C* and the double V-block *D*. Rubber inserts are provided in each of the two clamping bars *C* to compensate for any variation in the diameters of the pistons. The four guide pins *E* are set at an angle of 5 degrees so that the clamping action is downward, thus pushing the spherical seats of the pistons against pins *A*.

When the pistons have been clamped lightly in the fixture, the ends to be ground are tapped with a rubber mallet to insure that their spherical surfaces are seated firmly on the pins. Then the hand-knob is again rotated to clamp the pistons securely. By providing two such fixtures for each operator, twenty pistons can be loaded and clamped while twenty more are being ground. When the pistons have been ground and clamping stud *F* loosened, the four springs *G* push clamping bars *C* back to their original positions and permit easy removal of the pistons.

V-block *D* is screwed and doweled to base *H* of the fixture, and pins *A* are pressed into the base. Care must be taken in manufacturing the fixture to insure that the holes reamed in the base to accommodate the pins are all parallel. The upper ends of the pins are polished to a radius slightly smaller than that of the spherical seats in the pistons, and the distances from these ends to the shoulders that rest on the base of the fixture must be uniform within close tolerances. Dowel *J*, driven through a notch in the head of stud *F* and into clamping bar *C*, prevents the stud from turning when hand-knob *B* is rotated.

A Flush-Pin Gage that Utilizes Wedges for Inspecting Angular Surfaces

By F. SERVER

The gage illustrated utilizes a flush-pin and wedges for inspecting the relationship between various angular surfaces on part *X* and two holes in the part. Side plates *A* and *B*, separated by a block *D*, straddle the work, which is shown by dot-and-dash lines. The part is located by two pins *E* which enter holes at *F* and *G*.

The relationship between surface *H* and the holes in the part through which the knurled pins *E* pass is checked by means of a flush-pin *J*, a step *K* on the face of the block *D* indicating whether the part comes within the required tolerance. A small pin *T* passing through an elongated slot in side plate *B* facilitates movement of the flush-pin.

The relationship between angular surfaces *M* and *P* on the work and the holes is inspected by wedge-shaped blocks *L* and *N*. The two blocks are identical, except that they are right- and left-hand. The surfaces are inspected by placing the wedges in the position shown, with their inner edges against the sides of the work. A line at *R* must register between the edges of the slot *S* in the side plates if the relationship between these surfaces and the holes is correct.

* * *

Stevens Institute Receives Taylor Collection

A collection of personal papers and mementos from the estate of the late Dr. Frederick W. Taylor, "father of scientific management," has been presented to his alma mater, Stevens Institute of Technology, Hoboken, N. J. The collection includes manuscripts, rough drafts of books, records on the application of the Taylor system in various plants, and a scientific library.

* * *

The automotive industry in the United States used nearly four billion square feet of sheet steel during 1949 to build bodies for 5,100,000 passenger cars. This represents enough steel to build a wall around the nation's land and sea boundaries nearly 70 feet high.

* * *

One hundred years ago the first iron made from Lake Superior ore was tapped at the Carp River Forge in Michigan. The forge made little iron and no money. Lake Superior ores now supply about 82 per cent of the nation's needs.

Machine Tool Builders Discuss Selling Problems

VARIOUS phases of machine tool selling held the spotlight during the forty-eighth spring meeting of the National Machine Tool Builders' Association on May 3 to 5, inclusive, at the Edgewater Beach Hotel, Chicago, Ill. David Ayr, president of the Association and president of the Hendey Machine Co., Torrington, Conn., forecast a continuing gradual improvement in machine tool sales, and pointed out that, with price competition again in full sway, the difficulties encountered by the customers of the machine tool industry presented a great opportunity for that industry. With no relief in sight from high wages and taxes, manufacturers can turn only to the machine tool industry for aid in reducing product costs.

Mr. Ayr reported that business, in general, in the machine tool industry is definitely on the up grade, but that there has been no boom as reported by newspapers. The latest Association figures show total orders for March of approximately $31,700,000. Sales are now slightly in excess of shipments, whereas a year ago, the opposite situation existed. Mr. Ayr read excerpts from many newspapers that ridiculed Philip Murray's recent charge that the use of high-productive machinery causes unemployment.

In his paper on constructive selling, Swan E. Bergstrom, vice-president, Cincinnati Milling & Grinding Machines, Inc., Cincinnati, Ohio, mentioned that there are approximately 3360 men who sell the products that the machine tool industry manufactures. He stated that the future of the machine tool industry depends on the ability of these salesmen to get enough business to maintain full employment.

Technical skill and engineering ability have always been demanded of these men to meet the requirements of the customer who has a new product to make or a new plant to equip. Mr. Bergstrom pointed out, however, that the task of the machine tool salesmen of the future is to seek a much larger market which offers a far greater volume of business than can be obtained through new projects. He referred to the replacement market in the United States, which, he emphasized, was the biggest market that the industry had ever had.

Replacement formulas were discussed by Everett M. Hicks, assistant manager, Grinding Machine Division, Norton Co., Worcester, Mass., who illustrated his discussion with a method of analysis that is used by his company to determine the monetary advantages of new equipment over obsolete machines.

L. W. Scott Alter, president and general manager of the American Tool Works Co., Cincinnati, Ohio, summed up his paper "What to Do about This Equipment Crisis" with this comprehensive analysis of the advantages to be derived from replacing obsolete equipment:

"Equipment modernization inevitably results in larger quantities of less costly goods, so that the material enjoyment of life may be distributed in ever widening circles.

"Equipment modernization inevitably results in greater national security against the threat of being over-run by foreign enemies.

"Equipment modernization progressively increases the output per man without adding to his physical effort, and thus insures the enjoyment of whatever provisions he may have made for his old age instead of this being made a mockery through creeping inflation.

"Equipment modernization results in finer and more accurate and easily repaired products."

L. D. McDonald, vice-president of the Warner & Swasey Co., Cleveland, Ohio, made a report concerning the activity of the Government Relations Committee, of which he is chairman. Ralph J. Kraut, president and general manager of the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., discussed the possibilities of selling machine tools in various European countries that he had recently visited. The speaker at the dinner was W. Walter Williams, president of Continental, Inc., Seattle, Wash., and chairman of the Committee for Economic Development. Mr. Williams' subject was "Economic Tools for Progress." Mr. Williams cited five principles which, in his opinion, formed the economic foundation of constructive collective bargaining.

The Sales and Service Committee of the Association mentioned that the Sales Training Course which has been sponsored jointly for two years by the National Machine Tool Builders' Association and the American Machine Tool Distributors' Association, will be given again this summer. One session will be held at Cornell University from July 31 to August 4, inclusive, and another session at Purdue University from August 21 to August 25, inclusive.

Unusual Tooling Forms Large Pipe

LINE pipe from 26 to 36 inches in diameter and 40 feet long is formed in hydraulic presses by the National Tube Co., of McKeesport, Pa. Adjustable tooling, developed by the Verson All-steel Press Co., Chicago, Ill., is being used for the first time in forming such large-diameter pipe. The long steel plates are formed to a U-shape on a 2000-ton Verson hydraulic press in a complete forming cycle of only 38 seconds. Adjustment of the die for both size of pipe and thickness of plate (which varies from 1/4 to 5/8 inch) can be made without removing the tools from the press.

The pipe is closed in a subsequent operation by dies consisting of a pair of master shoes with different inserts for each pipe size, as shown in Fig. 2. Both upper and lower dies are half-round in shape. After the closing operation, the pipe is placed in a jig and butt-welded.

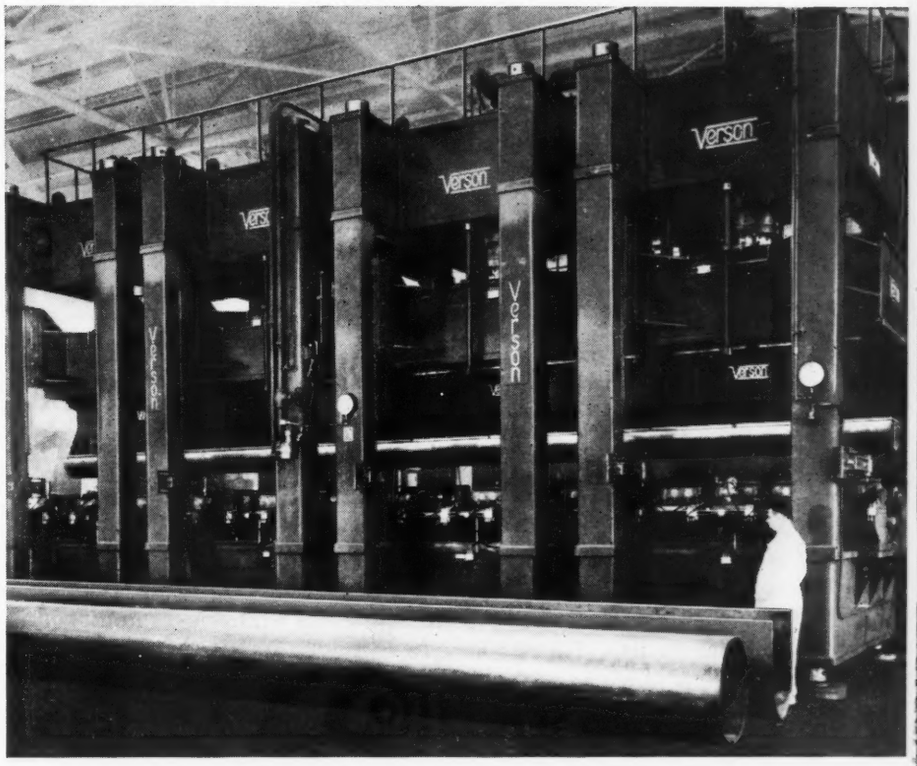


Fig. 1. Steel plates 40 feet long are formed to a U-shape on the 2000-ton hydraulic press here illustrated, in manufacturing line pipe ranging from 26 to 36 inches in diameter. An end view of the press showing the adjustable tooling used is seen in Fig. 3.

Fig. 2. Dies employed for closing the U-formed plates. Different inserts can be placed in the master shoes to close various sized pipe

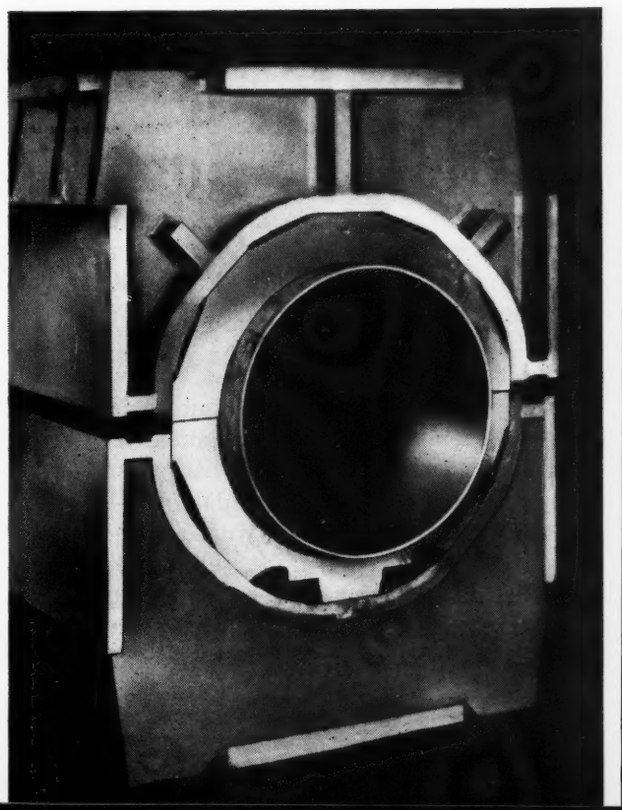
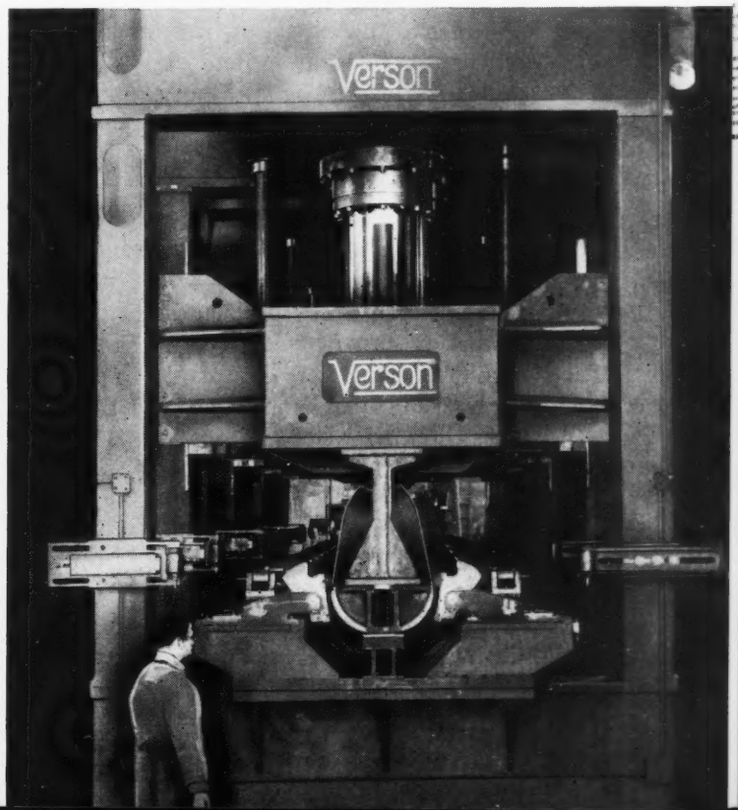


Fig. 3. View showing U-forming dies with the punch at the bottom of its stroke. These dies are adjustable for various pipe sizes



THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER
Lester, Hankins & Silver
Sales Management Engineers
New York and Philadelphia

Who's the Better Salesman?

DID you ever consider that each prospect is a salesman? Whether we get the order usually depends upon whether we are a better salesman than the prospect. Where we try to sell shop equipment based on its results, our prospect usually endeavors to sell ideas that are hurdles to us. He will try to convince us that our sales story is of less importance than other matters; his time is more valuable than ours; his present machining methods are satisfactory; our engineering skill and recommendations are inferior to another salesman's; our machine or tool is not the best for his purpose; our reputation and performance are not "tops"; our price is too high.

All these ideas look negative to us. Usually his sales tactics are defensive. But they are his sales arguments, even to the point of aloofness to our whole sales approach. Every step we take in selling may be met by some counter move on his part which handicaps our progress. Yes, both the prospect's action or inaction represents his success or failure in being a better salesman than we are. The keenest competitor we meet is really the prospect himself.

The prospect tries to sell us a package labelled "Successful Resistance." We attempt to sell him a package labelled "Complete Acceptance." His package is often wrapped up—contents concealed—leaving us to discover what's in it. Our package must be unwrapped so as to show him exactly what it contains and prove that it is worth more to him than the money we ask.

What are the initial steps of procedure in selling our package?

1. Ask an intelligent question relating to his particular interests. Few prospects will avoid this. In so doing, the first step is taken toward personal contact, and the reply informs us better how further to proceed. It's the old approach of the canvasser to the housewife—attracting her interest by asking some suitable question regarding her child.

2. Identify one of the prospect's main problems through question and answer. This gives a point of focus upon which to proceed—a common ground for solving the problem then and there or making a commitment to do so through further moves on our part or by applying analytical data which must be furnished at a suitable time.

3. Broaden the base of contact with the prospect's organization by identifying each person who will be affected by the solution of problems to be solved.

Ordinarily we don't get orders merely by following correct initial sales tatics. We must also establish confidence. The best way to establish confidence is by providing a service to the prospect. It may be furnishing a drawing or technical data, or arranging to bring in one of our headquarters' engineers.

Some years ago, when Charles Schwab (often termed the master salesman of his time) was living, a neighboring farmer led his cow over to Schwab's farm in Pennsylvania and tried to sell her to him. "It's a mighty fine cow," said the farmer as he ran his hands over the cow's head, flanks, and hocks. "She's well marked—got a good lookin' coat. She's kind and the gentlest cow in this here county."

"But does she give any milk?" asked Schwab.

"Ain't versed so well on that," answered the farmer, "but she sure is the kind of cow that'll give yer all she's got, if she's got any."

In short, we can't sell shop equipment as the farmer tried to sell Schwab his cow—by showing how smooth we are and what a nice machine or tool we have. We must sell results, based upon the performance of the tool, our company, and ourselves. That is the only way we can outsell our prospect.

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

"Visual-Grind" Contour Grinding Machine

Three different techniques can be employed for optical contour grinding on a new machine known as the "Visual-Grind," now being manufactured by the Cleveland Grinding Machine Co., 6514 St. Clair Ave., Cleveland 3, Ohio. Each of these grinding techniques, known as image, profile, and templet, is especially advantageous for a specific purpose.

The fact that the three techniques can be used on the same machine is said to eliminate many of the involved set-ups required when ordinary contour grinding methods are employed. With the new machine, shown in Figs. 1 and 2, there is also the advantage that inspection is continuous as grinding proceeds, thus making frequent reference to a comparator unnecessary.

The "Bounce-Back" feature incorporated in this machine makes possible "Reflecto-Image" grinding. With this arrangement, the light, descending from its source in the lamp house, as shown diagrammatically in Fig. 3, is condensed onto an oblique reflector which directs the beam to the left against the front of the work-piece. The image is reflected horizontally to the right through an aperture in the reflector, passes through precision lenses for magnification, and is projected on the screen without inversion or reversal.

The "profile projection" technique is employed by placing an auxiliary mirror behind the work-piece. The light that passes the work and the grinding wheel is reflected back through the aperture and through the lenses to the ground-glass screen. A profile of the work-piece shows as a sharp, dark image on the brightly illuminated screen. The profile method is ideal for all jobs in which front and rear surfaces of the work-piece are alike in size and shape or profile.

The templet technique combines "Reflecto-Image" and "profile projection." A polished precision templet of the shape desired is fastened to the front of the work-piece. Views of both templet and work-piece are projected on the screen simultaneously, as shown in Fig. 2. The work-piece can then be accurately ground to the desired form by matching its greatly magnified image with that of the templet. Templet grinding opens new possibilities in that the templet readily guides stock removal when wide contours at high magnifications are too large to be drawn on the screen. No drawing need be scribed on the screen.

By combining the image, profile, and templet techniques, any requirement in the form-grinding of tungsten carbide can be met with exceptional ease of operation and precision. The "Visual-Grind" machine also reduces diamond

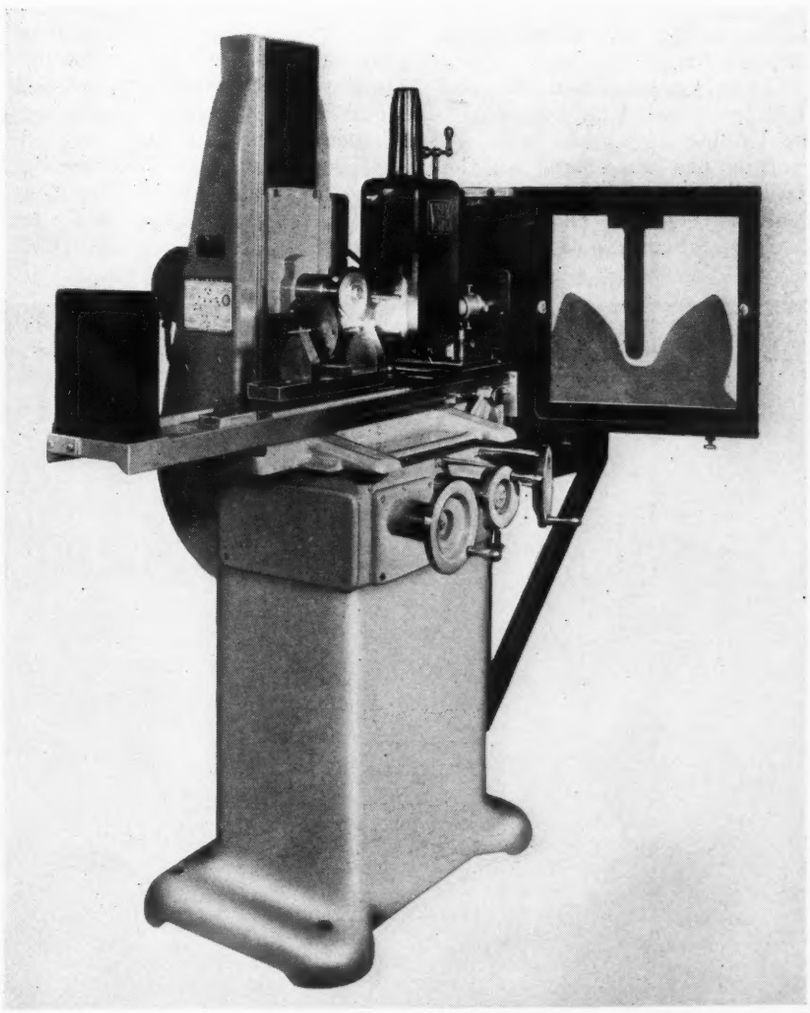


Fig. 1. "Visual-Grind" contour grinding machine manufactured by the Cleveland Grinding Machine Co.

To obtain additional information on equipment described here, use Inquiry Card on page 225.

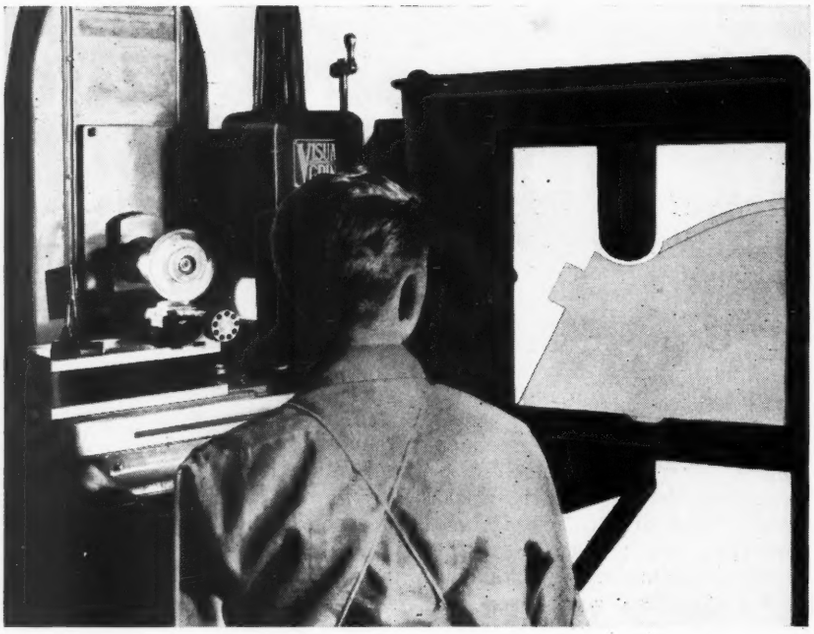


Fig. 2. Profile grinding on new "Visual-Grind" machine

wheel costs because the form is generated by progressive movements, which are directly controlled by magnification.

The selected matched lenses afford the finest definition, adjustment being easy and quick. All controls are convenient, so that the operator works rapidly with negligible eye or body fatigue. The lamp house, optical system, and light hood are so placed as to escape the hazard of grinding dust. The usual ground-glass viewing screen is recommended, though bright-line or other type screens used on comparators can be employed. Four standard magnifications are available. The machine has a work capacity of 6 by 16 by 8 inches high, using a 7-inch wheel. ---------- E-61

"Red Ring" Gear Sound Tester

The trend toward increased use of automatic transmission in automobiles has increased the demand for quieter, smoother running gears. To meet this demand, more rigid testing of gears for quiet operation prior to assembly has become imperative. For this purpose, the National Broach & Machine Co., 5600 St. Jean Ave., Detroit 13, Mich., has developed an improved "Red Ring" gear sound tester designated Model GSQ.

Both operating heads of the new tester now have their own direct-current motors, controlled through a single rheostat. These motors operate in the same direction of rotation and at any selected speed within the range of gear operation in actual service. The gear set or sub-assembly under test may be driven by either head, while the opposite head is used as a brake or to simulate gear loading under actual running conditions. The amount of loading is also variable, so that any condition encountered in actual service can be duplicated in the test, such as power to input and brake output; power to output and brake input; running free; coasting; slowing down; or stopping.

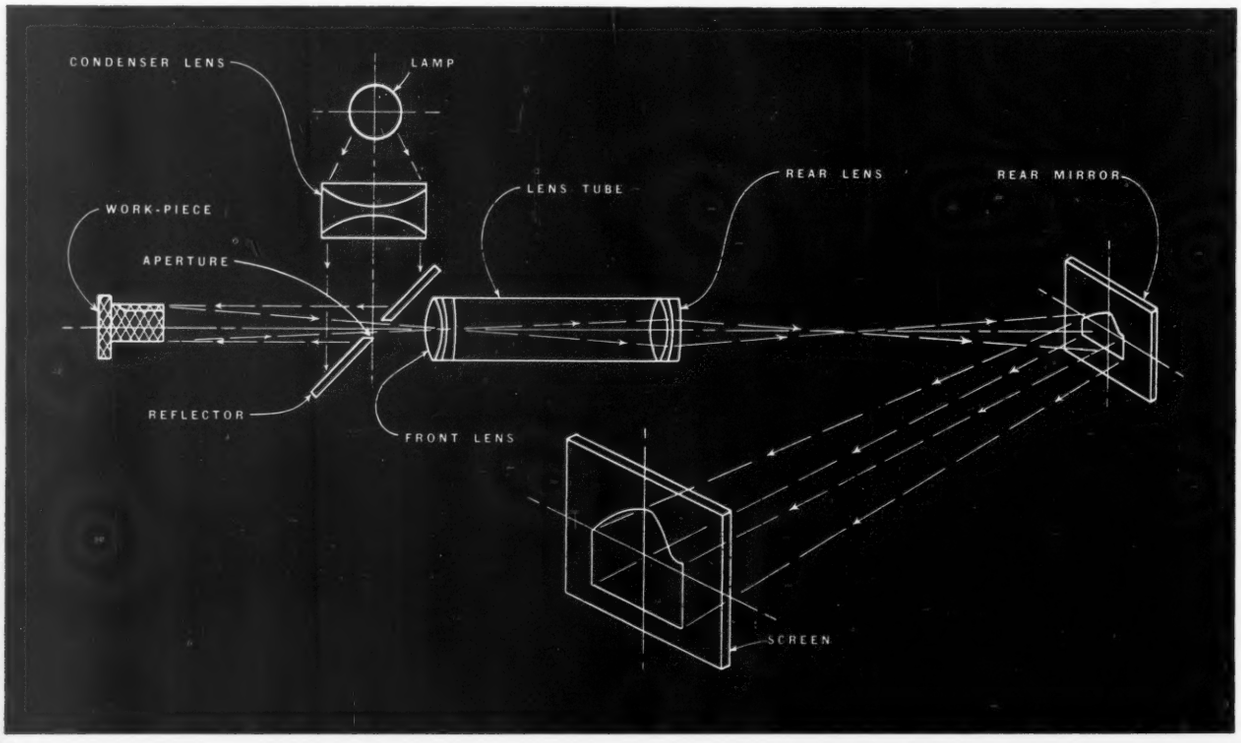
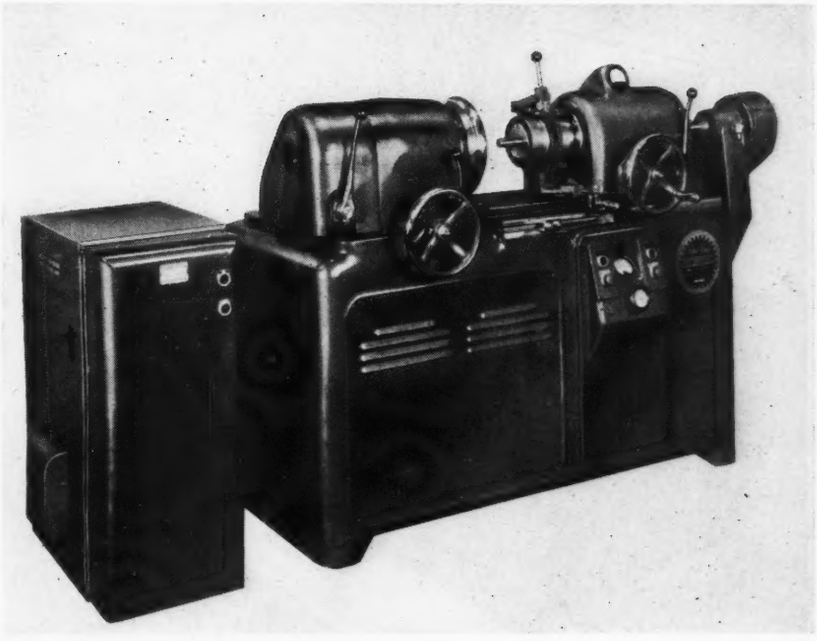


Fig. 3. Diagram showing arrangement of light, screen, and lens system of "Visual-Grind" machine

To obtain additional information on equipment described here, use Inquiry Card on page 225.

The test load is indicated by an ampere meter, and a tachometer registers the speed, so that a record of gear performance can be made for any combination of load and speed.

The sound tester will accommodate either internal or external gears, and is built in two sizes, one for gears up to 14 inches in diameter and the other for gears up to 24 inches in diameter. Air clamping can be added to facilitate loading and unloading. E-62



"Red Ring" gear sound tester developed by National Broach & Machine Co.

Plastic Protecting Cover for Welding Plates

A clear plastic cover plate designed to protect welding plates from damage is announced by the American Optical Co., Southbridge, Mass. It is claimed that the methyl methacrylate plastic used for this cover plate does not become pitted as readily from welding spatter as the glass plate ordinarily used. The new plates are made 0.060 inch thick to assure adequate impact resistance. The standard size is 2 by 4 1/4 inches. ---------- E-63

Cross Special "Transfer-Matic" and New Machine Control Unit

A saving of as much as 82 per cent in the time required to change tools is one of the chief advantages claimed for a machine control unit just announced by The Cross Company, Detroit 7, Mich. Other advantages resulting from the use of this unit include reduction of scrap material and simplification of tool grinding operations. The "Transfer-Matic" machine shown in Fig. 1 equipped with the new control unit was developed for use in the production of automatic transmission cases.

This machine is equipped with automatic devices to transfer the work from station to station. Eighty-three cutting tools are used

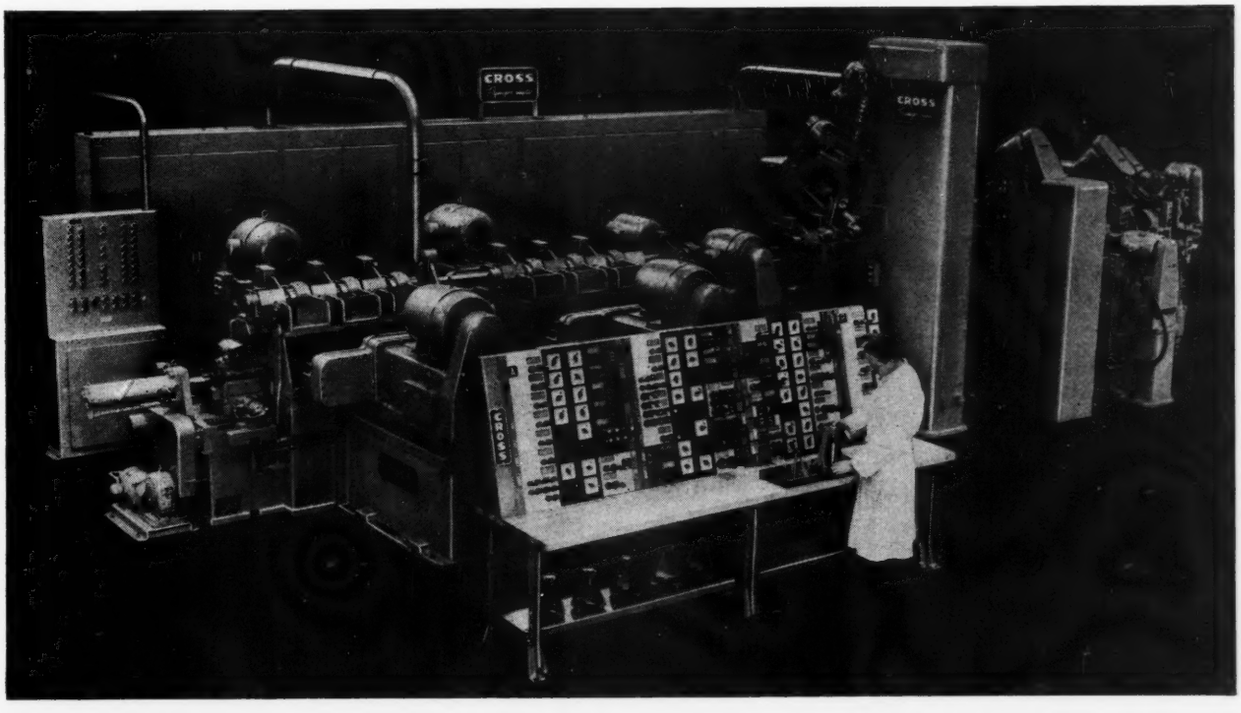


Fig. 1. Cross special "Transfer-Matic" with new "Toolometer" control unit designed for machining automatic transmission cases

Fig. 2. Close-up view of tool-setting fixture and two types of gages for pre-setting tools used on "Transfer-Matic" shown in Fig. 1

in machining the cases. Such a large number of tools naturally places a burden on the operator, which can only be relieved by providing mechanical means, like the control unit, to keep accurate records of the tools and to speed up tool-changing operations.

Basic components of the new control unit are a master control board, shown in the close-up view, Fig. 3; a master tool-setting fixture, Fig. 2; a work-bench; and "Toolometers," also seen in Fig. 3, which automatically shut down the machine when the tools need changing.

The control board is divided into sections for each type of tool in the machine. Every section is provided with a tool-setting gage, a tag with the perishable tool and holder numbers, storage space for two complete sets of tools and holders, and a "Toolometer." Alphabetical letters on the board and corresponding ones on the machine heads further group the tools and guide the operator. Colored areas on the control board help locate the machine head; for example, yellow indicates a right-hand horizontal head, red a left-hand horizontal head, and blue a vertical head. The tags with the perishable tool numbers provide the operator with constantly available information for replacing worn parts or tools.

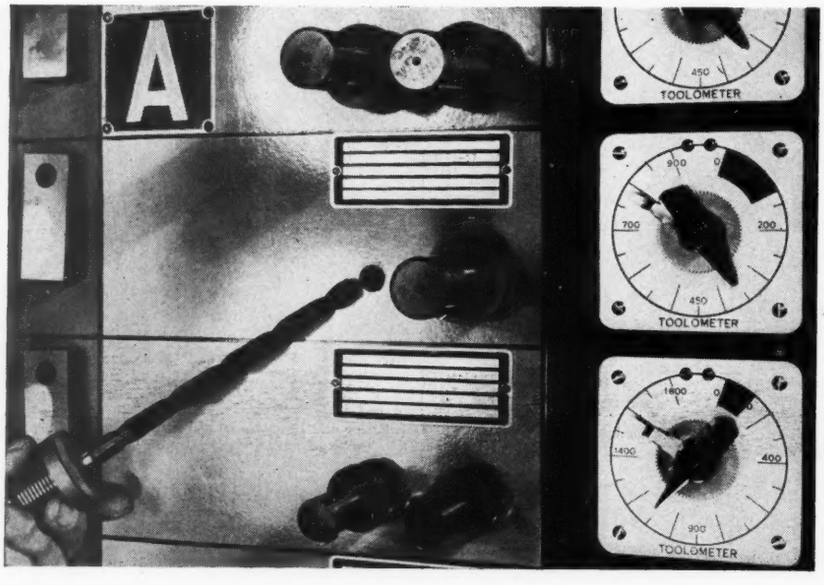


Fig. 3. Section of control board illustrated in Fig. 1, which shows arrangement of tool-setting gages, pre-set tools, identification tags, and "Toolometers"

The "Toolometers" provide visual records of the used and unused life of every type of tool in the machine by means of pointers, which index counter-clockwise with every machine cycle. When any one of the pointers reaches zero, the machine stops automatically. Red areas on the "Toolometer" dials adjacent to the zero marks represent danger zones for the last two hours or other appropriate period of productive tool life. When one of the "Toolometers" stops the machine, all tools in the danger zone are replaced. The "Toolometers" are then reset by manually turning the pointers clockwise to positive stops, which establish starting positions. The stops are adjustable for various types of tools and amounts of work.

All tools are assembled in adjustable holders and pre-set to standard lengths with gages on the control board, which are used in conjunction with the master tool-setting fixture. Then the tools are placed on the control board ready for use when needed. Two sets of tools are provided, so that if one tool is damaged during installation, a second one is available and no time is lost in reassembling a new tool. Time studies show that actual changing of a pre-set tool requires only two minutes, compared with seven minutes for making a conventional tool change. E-64

Airco Welding Gloves

Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y., announces three new styles of welding gloves. The "A" gloves are made of soft, rugged carpincho leather with a wool-lined back for maximum heat resistance. The one-piece leather back, which includes fingers and gauntlet, is designed to eliminate exposed seams and to increase the life of the glove. Styles "B" and "C" gloves are of similar construction but lower in price. All three styles are medium-full size. E-65

To obtain additional information on equipment described here, use Inquiry Card on page 225.

H-P-M Hydraulic Drawing and Forming Press

A 425-ton self-contained, all-hydraulic press designed for deep-drawing and forming tractor and other farm machinery parts has just been built by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, for the International Harvester Co. The press is of the single-action design, and has a 133-ton die cushion installed in the bed.

It has a 24-inch stroke, pressing surface of 60 by 48 inches, and is operated by the H-P-M closed circuit system. This hydraulic system is designed to provide a fast cycle, constant drawing speed, smooth operation, shockless reversal, and full protection from damage to the press and equipment by overloads.

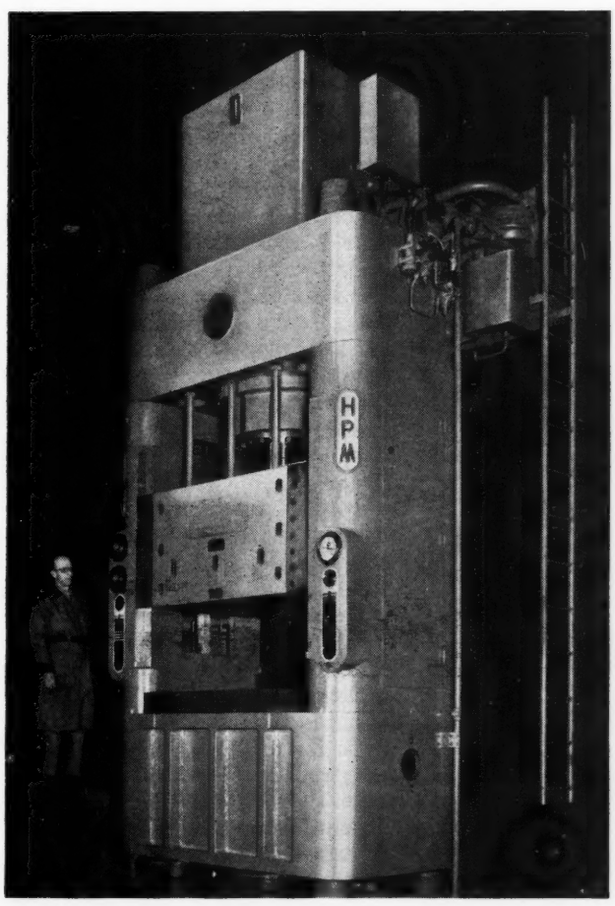
There is ample clearance on the press bed to facilitate quick changing of dies, which is particularly advantageous where short runs of work must be regularly handled on a mass production basis. ---------- E-66

Fosdick Jig Borer with Table Equipped for Automatic Positioning

Accurate, rapid, and automatic positioning of the slide and table, under push-button control, are outstanding features of a jig borer just placed on the market by the Fosdick Machine Tool Co., Cincinnati 23, Ohio. Through the use of duplicating bars for both slide and table, work can be automatically positioned to within plus or minus 0.0001 inch in approximately one minute. The duplicating bars are made with as many positioning holes as required for the work being handled, and can be kept on hand, ready for repeat orders. About four minutes per "positioning hole" is required for making the duplicating bars. Separate micrometer adjusting blocks are placed on the table and slide with the duplicating bars for locating the center of the first hole.

This new No. 42P machine is designed for reaming, boring, and tapping, as well as drilling. The spindle is guaranteed not to exceed 0.0002 inch run-out at the end of a 12-inch proving bar. With this equipment, the need for expensive jigs and fixtures previously required for many products is eliminated. Thus it makes possible many changes in product design that would be too costly if jigs and fixtures were used.

Automatic positioning of the table and slide is accomplished by four motors, two of which are used for rapid traversing and two for final positioning. These four motors, the main-spindle drive motor, and the lubricant-system motor are all under push-button control. After the duplicating bars are placed in their troughs in front of the indicators, it is only necessary to push the proper positioning button to cause the rapid-traverse motor to automatically traverse the table to within 1/16 inch of the final position. The rod then strikes a micro-switch, which breaks the current to the rapid-traverse motor and energizes the



Hydraulic self-contained deep-drawing and forming press brought out by Hydraulic Press Mfg. Co.

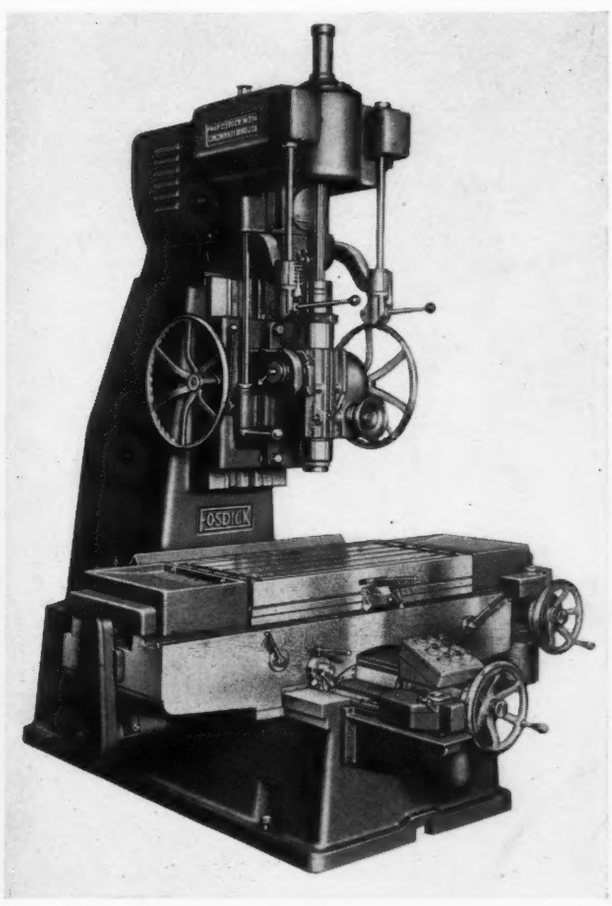


Fig. 1. Fosdick jig borer with automatic positioning table provided with push-button control

To obtain additional information on equipment described here, use Inquiry Card on page 225.

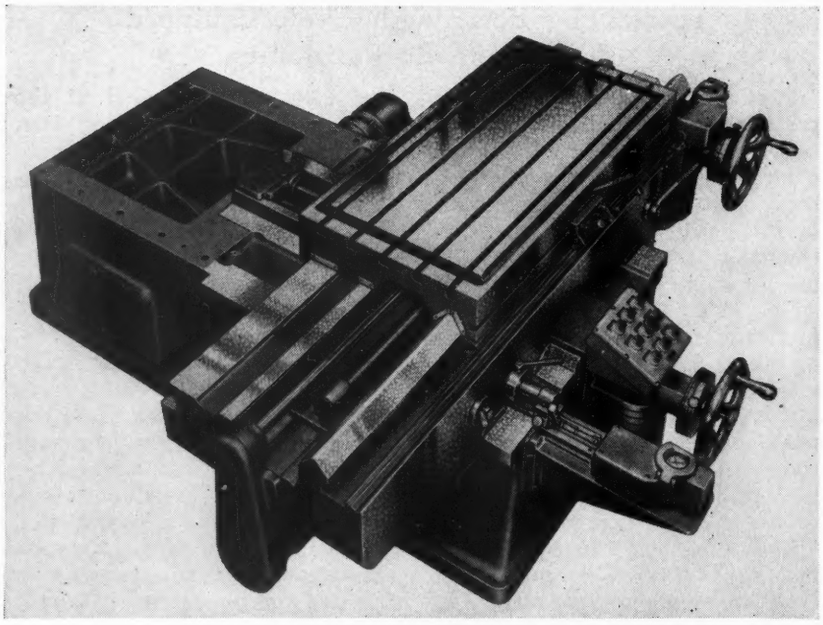


Fig. 2. Close-up view of table and base of machine shown in Fig. 1 with column and spindle removed

positioning motor which moves the table to the final position. After the table is positioned, the motor reverses and takes out all the backlash in the nut. The same operation is duplicated by the slide. It is possible to apply the rapid traverse motion to the slide and table simultaneously and to automatically position the table and slide simultaneously. This serves to cut down the positioning time approximately one-half.

The table has a working area of 22 by 44 inches, a longitudinal travel of 42 inches, and a cross travel of 18 inches. The maximum distance from table to spindle is 27 inches, the spindle travel 9 inches, and the head travel 12 inches. There are twenty-four speeds, ranging from 30 to 1500 R.P.M. Three optional ranges of feed are available. E-67

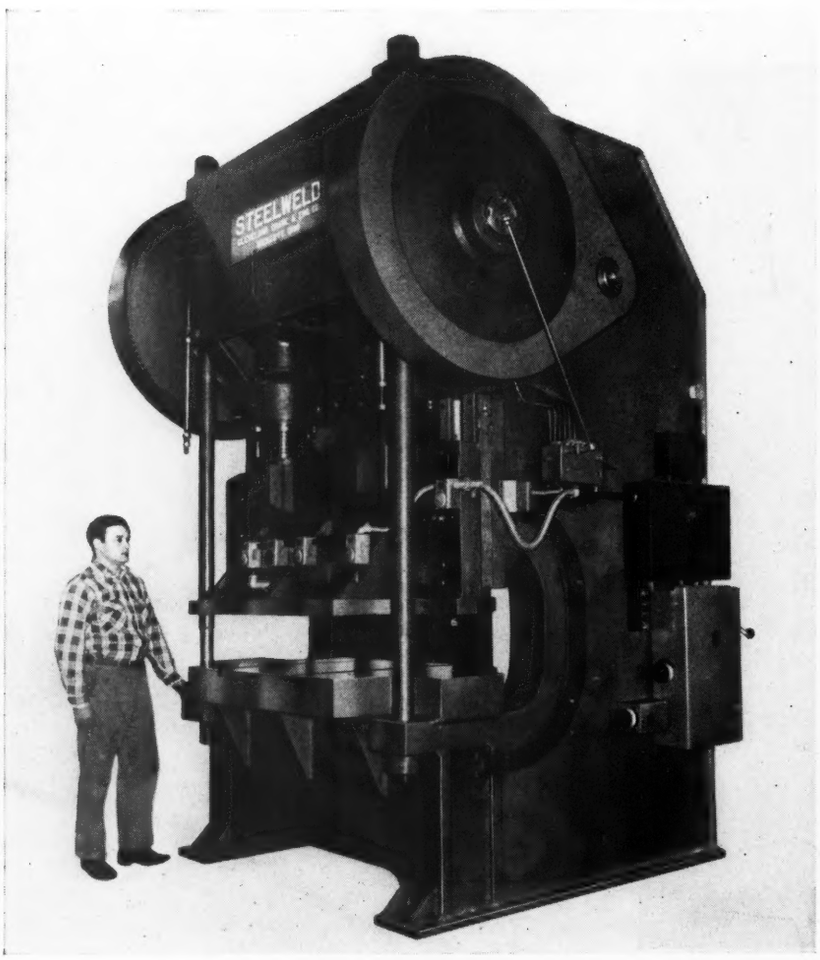
Special Steelweld Bending Press

A 300-ton Steelweld bending press for blanking out clutch rings, clutch gear teeth, and special flat work was recently built by the Cleveland Crane & Engineering Co., 5410 E. 281st St., Wickliffe, Ohio, for the S. K. Wellman Co., Cleveland, Ohio.

This machine has air-electric clutch control with a four-position selector switch, and is designed for two-man operation. The operators have simply to set the selector switch to any one of the four positions desired—namely, "long," "short," "continuous," or "inching" stroke—and depress the starting buttons.

Two sets of control buttons are provided, one at the front and the other at the rear of the machine. The arrangement is such that both operators have to depress the buttons to start the machine, yet either operator may stop the machine at any time. This gives the operators full protection while working on the machine.

The speed of the machine is 25 strokes per minute; the shut height is 14 inches; and the throat depth is 18 inches. The bed is 3 feet front to back by 4 feet between tie-rods. The tie-rods, which are supplied for additional rigidity, can be lifted out of the way, so that the entire length of bed can be utilized. Longer guides and larger bearing areas are provided for punching service. E-68



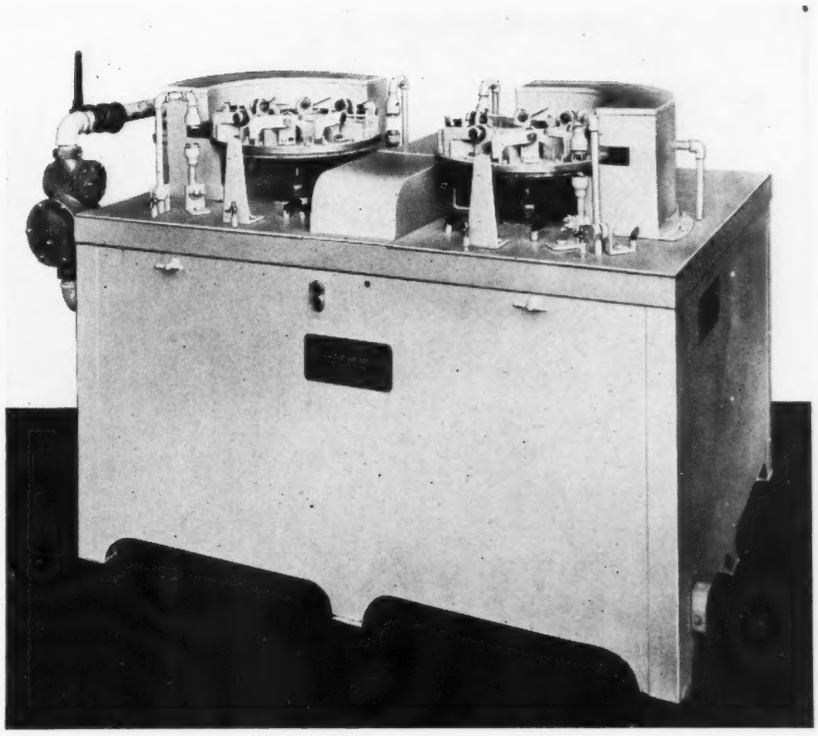
Special bending press with air-electric clutch control announced by the Cleveland Crane & Engineering Co.

To obtain additional information on equipment described here, use Inquiry Card on page 225.

Selas Radiant Gas Tool Hardening Machine

Heavy-duty chisels can be hardened and drawn in local sections of both ends at the rate of sixty per hour on an automatic gas-fired machine produced by the Selas Corporation of America, Erie Ave. and D St., Philadelphia 34, Pa. The chisels are loaded by hand on two turntables and held in position by tension arms. The hydraulic indexing movement of the turntables carries the chisels through seven stations where they are first heated by two open burners; second, quenched and hardened by two oil streams; third and fourth, washed off by two water streams; fifth, drawn by two open burners; sixth, cooled; and seventh, unloaded.

After one chisel end has been treated in the cycle of the first turntable, the chisel is reloaded to the second turntable, moving in the opposite direction, for similar treatment at the other end. The machine includes an oil recirculator and heat exchanger. Variable-speed control provides for changes in heating time if required. The fuel consumption is approximately sixty cubic feet of 1000 B.T.U. gas per hour. E-69

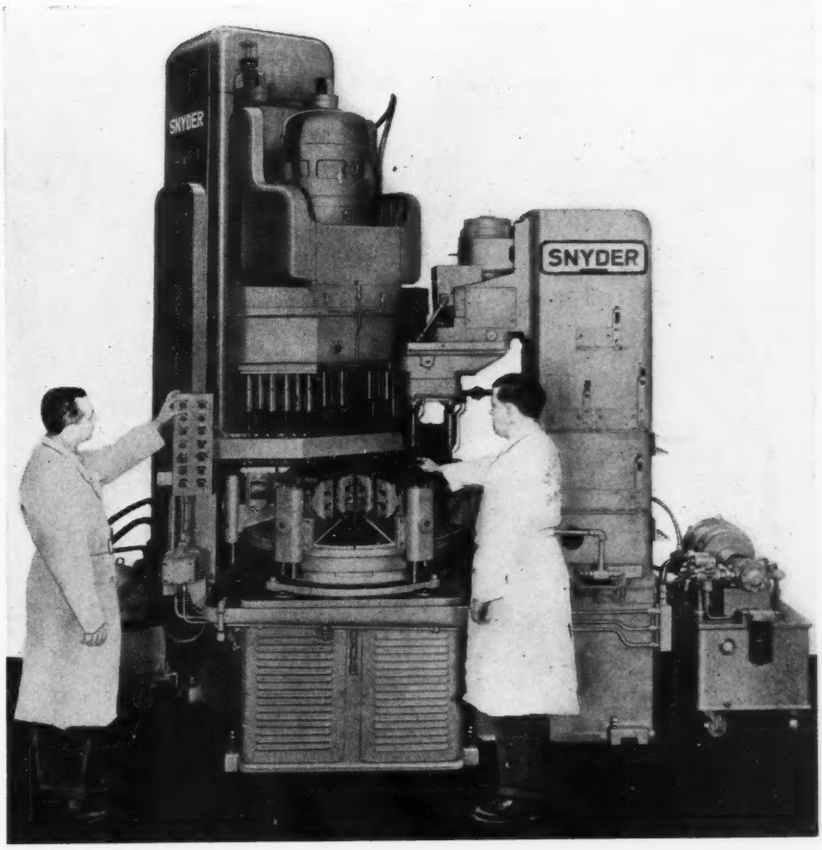


Radiant gas tool hardening and drawing machine made by Selas Corporation of America

Snyder Vertical Drilling and Tapping Machine

Differential bearing caps are drilled, spot-faced, chamfered, and tapped at the rate of 480 an hour at 80 per cent efficiency on a new six-station vertical machine built by the Snyder Tool & Engineering Co., 3400 E. Lafayette, Detroit, Mich. The work cycle requires only twenty-one seconds, and is automatic after the starting button is pressed. The machine is electrically interlocked to insure safety, and can be operated by unskilled labor.

Tool speeds are 260 R.P.M. for the larger drills and 1045 R.P.M. for the smaller units. The stroke is 3 inches. The main spindle head is driven by a 25-H.P. motor, the tap head by a 2-H.P. motor, and the Geneva index mechanism by a 2-H.P. motor. The hydraulic tanks each have a 3-H.P. motor. One hydraulic tank serves the drill press, and the other the clamping mechanisms. The machine requires a floor space of 140 by 86 inches. E-70



Six-station vertical drilling and tapping machine built by the Snyder Tool & Engineering Co.

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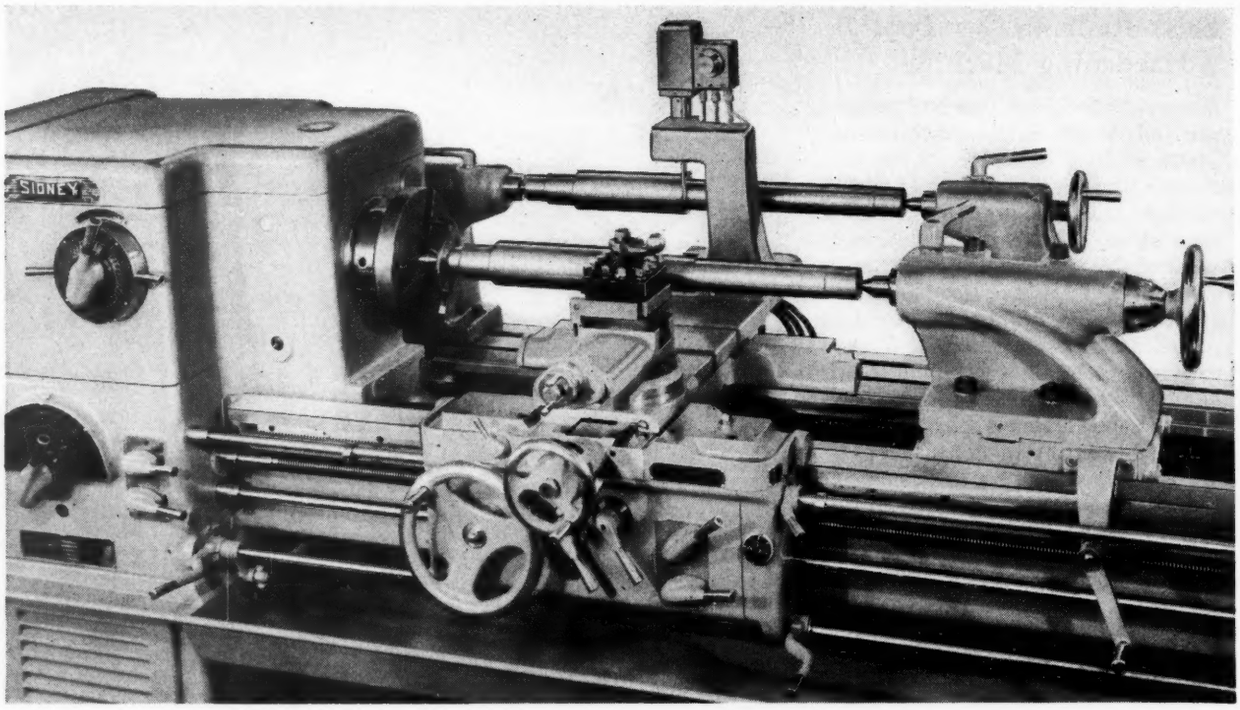

Fig. 1. Sidney lathe equipped with "Fluid Tracer" for turning formed and stepped work

Sidney "Fluid Tracer"

The Sidney Machine Tool Co., Sidney, Ohio, has recently brought out a new "Fluid Tracer" designed for use with any Sidney lathe. A lathe thus equipped (Fig. 1) serves the dual purpose of tracing from a master and performing regular lathe work. Conversion from tracer to regular lathe control is effected by moving a lever on the clutch and brake unit shown at the end of the lathe bed in Fig. 2.

With this tracer, there are no parts to put on or take off when a change-over from tracing to standard lathe operation is necessary. The regular compound and cross-feed assemblies are used, and are directly connected to a hydraulic cylinder mounted at the rear of the carriage.

The compound rest can be swiveled to any angle for turning or boring, and both the top slide and cross-feed dial can be used to set the tool for the desired depth of cut. If round templets are to be used, the master piece can be machined in the regular manner and then used as a templet. Longitudinal adjustment of the master can be made by the auxiliary tailstock centers. The center on the auxiliary tailstock nearest the headstock is spring-loaded, thus eliminating the necessity of resetting the cutting tool for close adjustments.

The tracer head is furnished with a three-way valve control for forward and reverse rapid traverse and feed to the cross-slide. The tracer head has two functions —it controls the cross movement of the tool as well as the hydraulically operated clutch and brake mechanism. The function of this clutch and brake mechanism is to synchronize the longitudinal movement of the carriage with the rate of cross-slide travel and also to by-pass the flow of oil when the tracer is not in use. E-71

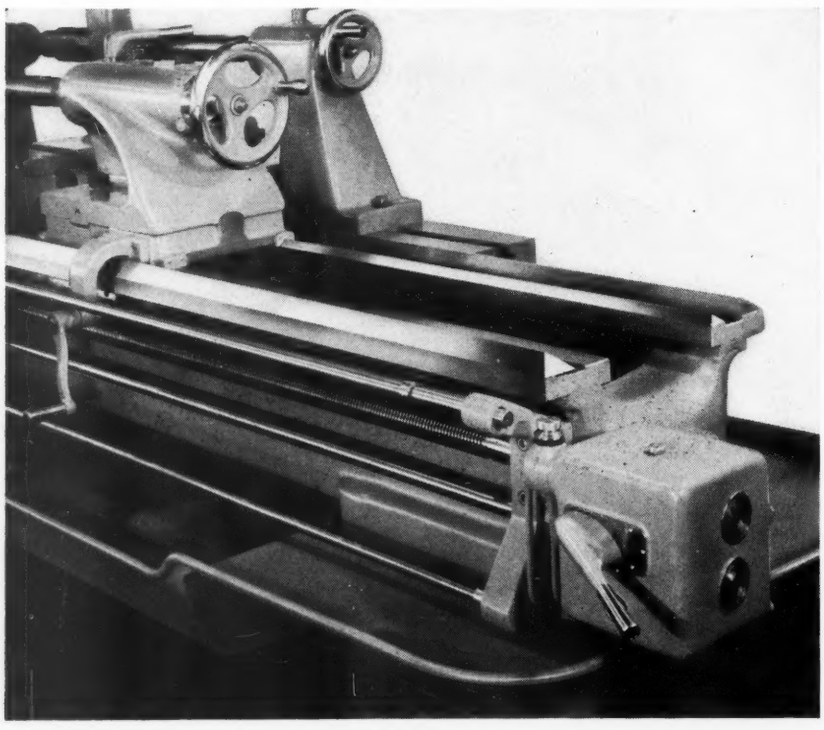

Fig. 2. View of tailstock end of lathe shown in Fig. 1

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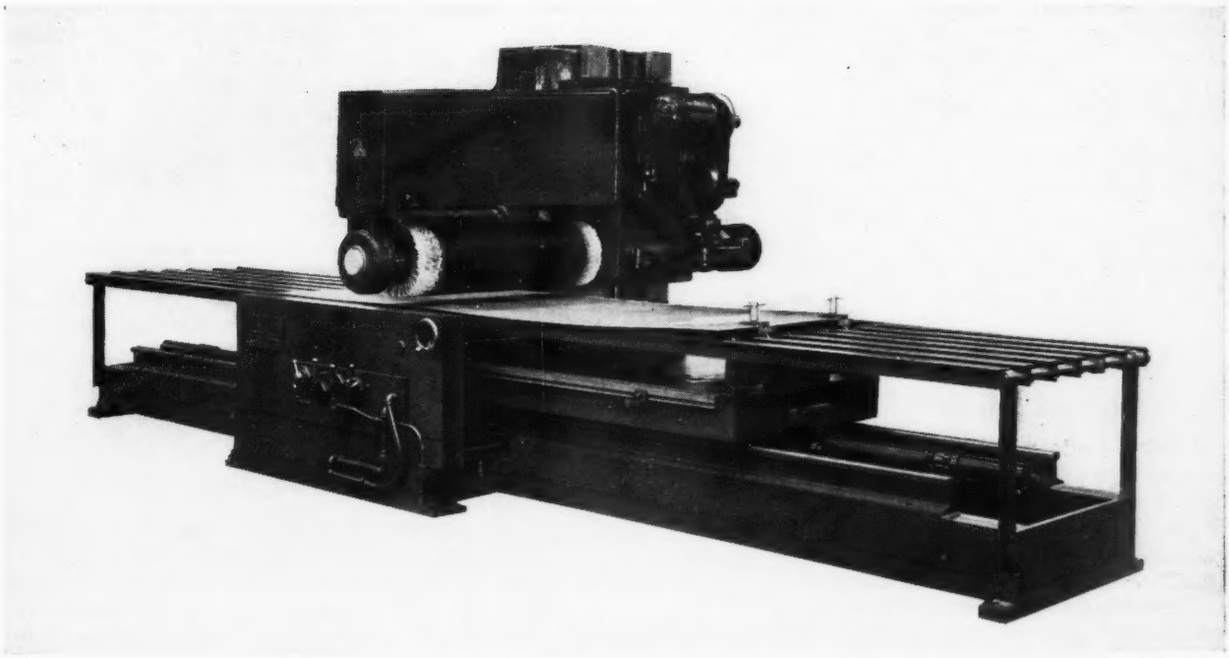


Oscillating roll type buffing machine brought out by the Hill Acme Co.

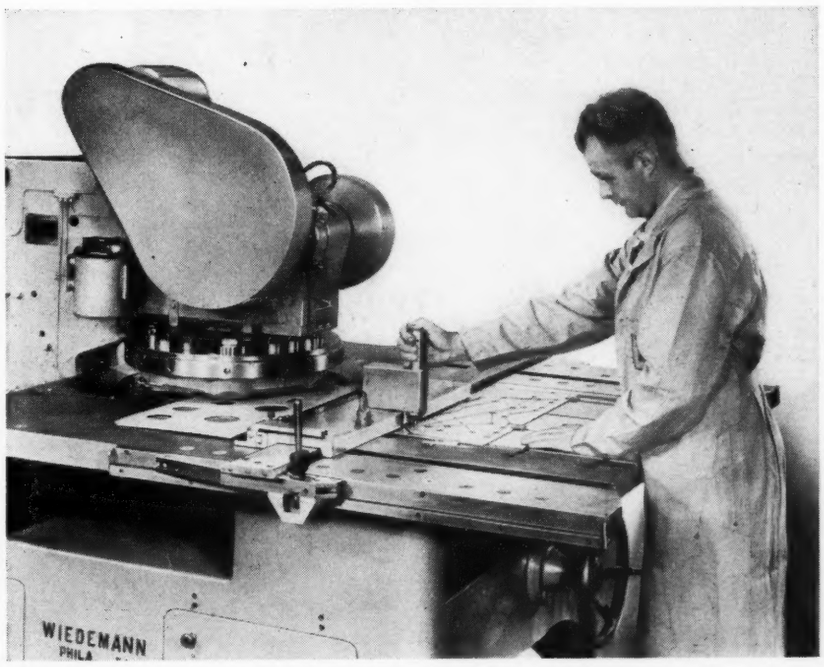
Hill Oscillating Roll Type Sheet Buffing Machine

The Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio, has brought out a new 48-inch wide open-side oscillating type sheet buffing machine with hydraulic table and power elevating and lowering head, using a buffing roll or Tampico brush roll 18 inches in diameter. It is recommended for heavy-duty finishing of ferrous and non-ferrous sheets.

This machine is built in table widths up to 72 inches and table lengths of 8 feet and over. The oscillating mechanism is driven by a 3-H.P. motor, and has a stroke adjustment of 1/2 inch to 2 inches, and a range of 50 to 150 cycles per minute. E-72

Wiedemann High-Speed Turret Punch Press

High-speed piercing of such work as electrical panels, radio and television chassis, and switchboards can be accomplished on a new turret punch press built by the Wiedemann Machine Co., Department 24, 4272 Wissahickon Ave., Philadelphia 32, Pa. This RA-41P press combines in one machine a pantograph developed for rapid location of work for piercing holes and a turret for quick selection of punches and dies.



Wiedemann turret punch press with novel material positioning feature

The turret carries sixteen to twenty different punches and dies in sizes up to 3 inches in diameter. These punches are designed for piercing round, square, or other shaped holes or groups of holes. Any punch and die can be quickly brought into the piercing position by rotating a handwheel.

The work to be pierced is clamped to the cross-slide in proper relation to a templet in which 1/4-inch diameter holes are accurately located to correspond with the center of each hole to be pierced in the material. All templet holes representing the same size punch can be connected by a colored paint line to form a visual chain for the operator to follow with the stylus. The free-moving stylus is guided by the operator from hole to hole in the templet,

To obtain additional information on equipment described here, use Inquiry Card on page 225.

which accurately positions the material under the ram. The press is automatically tripped, but only after the stylus point has engaged the templet hole.

The press will handle sheets up to 28 by 40 inches, and has a capacity of 15 tons pressure with an 11/16-inch stroke of the ram, which is operated at a speed of 175 strokes per minute by a 1-H.P., 3450-R.P.M. motor. E-73

Band Saw with Spiral-Shaped Blade

A spiral blade, which cuts on an entirely new principle, is a special feature of a band saw brought out by the Tyler Mfg. Co., Los Angeles 45, Calif., with eastern office at 60 Beaver St., New York 4, N. Y. Owing to its unique shape, the spiral blade presents a 360-degree cutting edge, which cuts smoothly in any direction, permitting the operator to cut and back out of any type pattern or shape without turning the material being worked on. The new blade, having a hardness of 81 on the Rockwell C scale, will cut through almost any material, including steel, wood, foam rubber, Masonite, Plexiglas, leather, etc.

The band saw is available in two models; the Model 100A has a 12-inch throat, an 8 1/2-inch clearance under the guide bar, a 4-inch blade-tension adjustment, and a table tilt of 45 degrees to the right and 5 degrees to the left. It is powered by a 1/3-H.P. motor. The Model 500A is the same as the 100A, except that it has a combination of variable-speed drive and planetary transmission, which provides a selective speed range of from 70 to 5000 feet per minute. The spiral blade with special adapters can be used on several conventional type band saws. The new band saw can also be used with standard type flat band-saw blades. E-74

Hisey "Economy" Grinders and Buffers

The Hisey-Wolf Machine Co., Cincinnati 8, Ohio, has just announced that its entire line of "Economy" grinders and buffers has been redesigned. The machines in this line are considerably lower in cost than the standard heavy-duty models built by the company. The new streamline pedestals of the redesigned machines have much larger floor bearing areas, which serves to reduce vibration to a minimum.

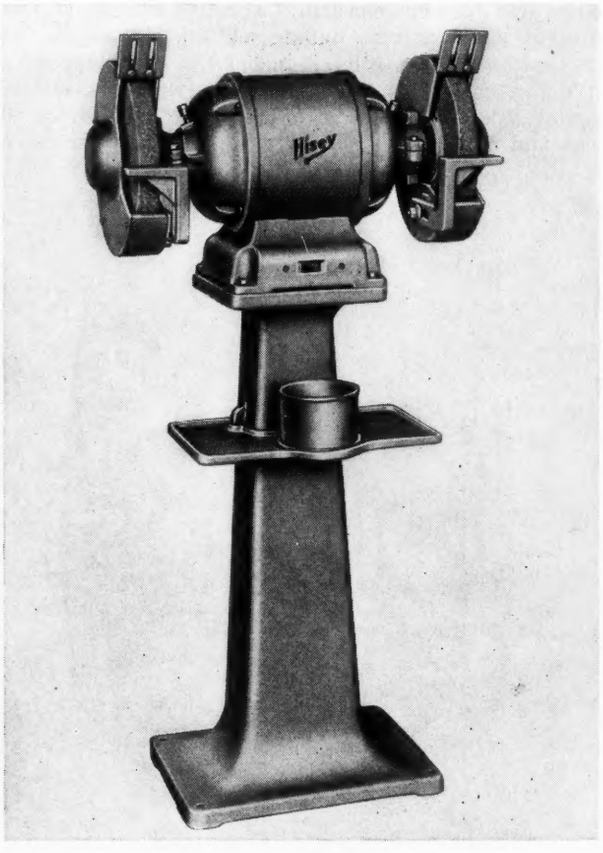
The bench model grinders are made in 3/4-, 1-, and 2-H.P. sizes, and the pedestal models in five sizes ranging from 3/4 to 5 H.P. They are designed for continuous service. The motors are totally enclosed, and the shafts are mounted on two shielded type ball bearings, arranged for grease lubrication. E-75

Elmes Molding Press

A special line of molding presses designed to handle the new low-pressure, fast-setting "alkyd" resins is announced by the Elmes Engineering Division of American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio. These "Minimatic" (miniature automatic) presses were developed in cooperation with a prominent manufacturer of the new mineral-filled molding compound.

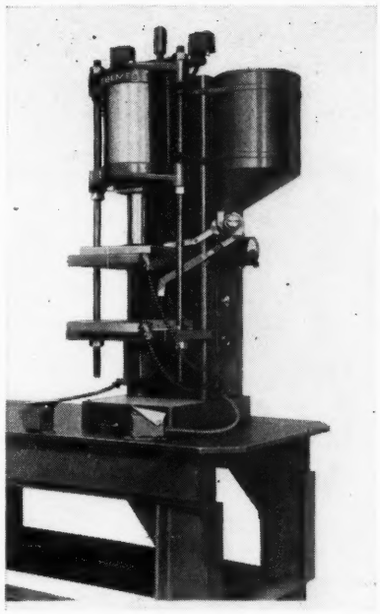
There is a choice of five cylinder capacities—3-ton and 6-ton for

Tyler improved band saw equipped with new spiral blade



"Economy" grinder and buffer built by Hisey-Wolf Machine Co.

To obtain additional information on equipment described here, use Inquiry Card on page 225.



Elmes special molding press

air application, and 0.6-ton, 1.2-ton, and 2.4-ton for hydraulic service. All cylinders are interchangeable in the basic frame. The press incorporates controls for completely automatic continuous operation or semi-automatic, single-cycle operation for insert molding. Operation is controlled by an exceptionally simple operating valve. E-76

Open-Back "Press-Rite" Power Press

An 85-ton open-back inclinable "Press-Rite" power press featuring a one-piece special alloy frame with built-in tie-rods to insure rigidity and strength has been added to the line of the Sales Service Machine Tool Co., 2363 University Ave., St. Paul 4, Minn. The built-in tie-rods reinforce the gap, and thus provide for a larger die space and added strength, as well as eliminating deflection on heavy work. The design of the tie-rod frame reduces binding or misaligning of dies on extra heavy drawing and blanking operations.

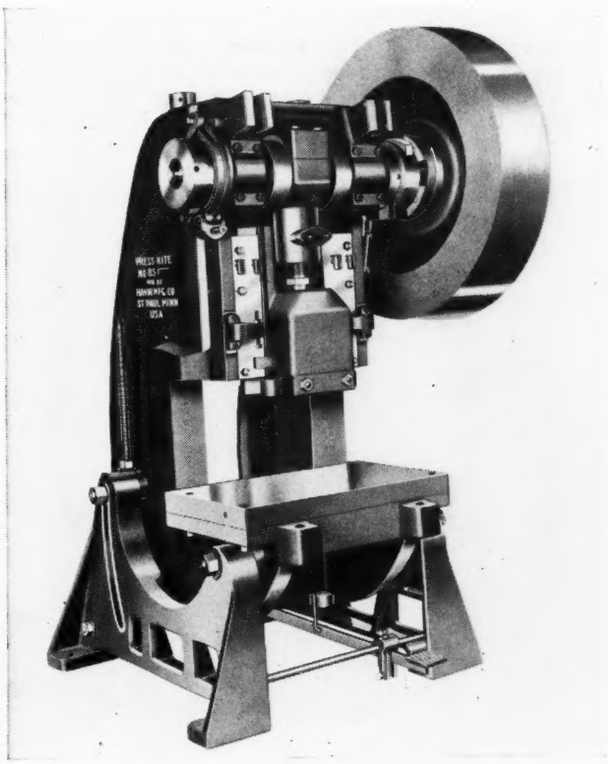
Other features include non-repeat single-stroke mechanism and automatic cam-actuated brake; anti-friction roller bearings in flywheel; and four-point engagement special sliding key clutch on flywheel drive or air friction clutch and brake on back-geared press. The ram slide is extra heavy, with large and long ram ways, triple lubricated and counterbalanced, with steel bushed hole for holding die shanks and ball and socket adjusting screw with take-up retaining ring.

The bolster area of this press is 22 by 36 inches, and the depth of throat is 12 inches. The shut heights and strokes are optional. There is no sacrifice in the weight of the press because of the built-in tie-rods, yet the height of the press from floor to center of crank is only 78 1/2 inches. E-77

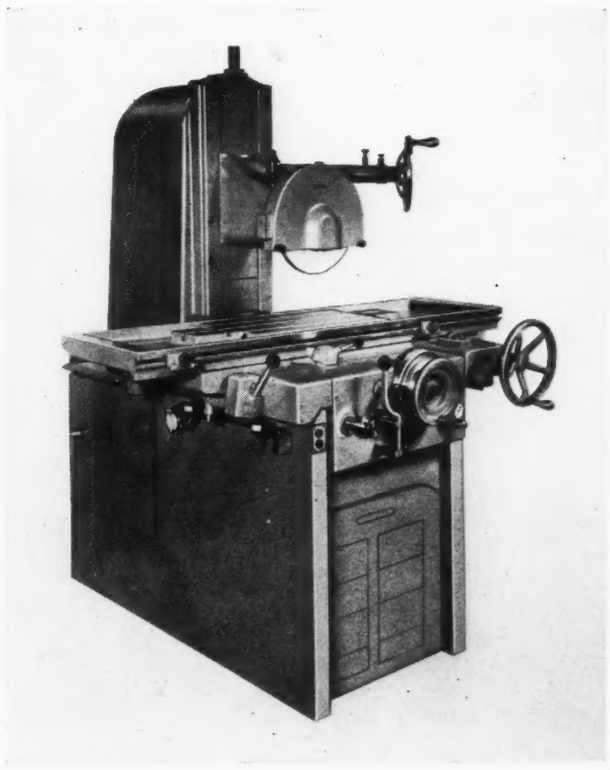
"Hydrabrasive" Surface Grinder

The first of a completely new series of hydraulically operated surface grinders has been announced by the Abrasive Machine Tool Co., 12 Dunellen Road, East Providence 14, R. I. This grinder, known as the No. 1218 Hydrabrasive, has an unusually wide cross travel of 12 inches, with a moderate table length of 18 inches. Power is supplied for the spindle by a fan-cooled, totally enclosed 3-H.P. motor, which drives a 12-inch wheel. The deep, massive base minimizes vibration. The speed range provides for slow crush-grinding at one extreme to fast conventional grinding at the other.

Table speeds are almost instantly adjustable from 1/2 foot per minute to 90 feet per minute, with a 3/8-inch cross-feed movement in 2/10 second, making possible appreciable savings in grind-



"Press-Rite" power press introduced by the Sales Service Machine Tool Co.



Hydraulic surface grinding machine built by the Abrasive Machine Tool Co.

To obtain additional information on equipment described here, use Inquiry Card on page 225.

ing time. In addition, the table speed can be reduced from 90 feet per minute to zero with only 1 inch run-over beyond the work.

The new machine has saddle ball ways which are of particular value when precision transverse adjustment is required, as in manufacturing gages, dies, etc. The machine can be equipped with special fixtures for high-speed production grinding. E-78

Barnesdril Magnetic Coolant Separator

Although the operating principle of the new style magnetic coolant separators announced by the Barnes Drill Co., 820 Chestnut St., Rockford, Ill., is the same as that of previous models, many changes have been made to improve them and widen their field of application. These changes have been made in separators having capacities of 5, 10, 20, and 40 gallons per minute.

The Barnesdril magnetic coolant separators are designed to maintain a uniformly clean supply of coolant for the machines by continuous separation and removal of the sludge, which consists of metallic particles and fused abrasives. This serves to reduce maintenance costs, coolant consumption, tool wear, and scratches on the work.

Improvements incorporated in the new separators include lightweight aluminum housings; design features that facilitate installation; 1/20-H.P. gear-motor that is said to reduce power consumption to a minimum; and reduction in floor space requirements.

The operating principle of the separator is shown in the cut-away view at the right in the illustration. The sludge separated from the coolant is discharged through the chute *A*, while the clean coolant is discharged through pipes on each side of the separator, the tapped hole for one of the pipes being shown at *B*. The coolant flows directly from the machine into the separator, where it passes through a restricted area between the separator housing and a cylindrical drum carrying Alnico magnets *C*.

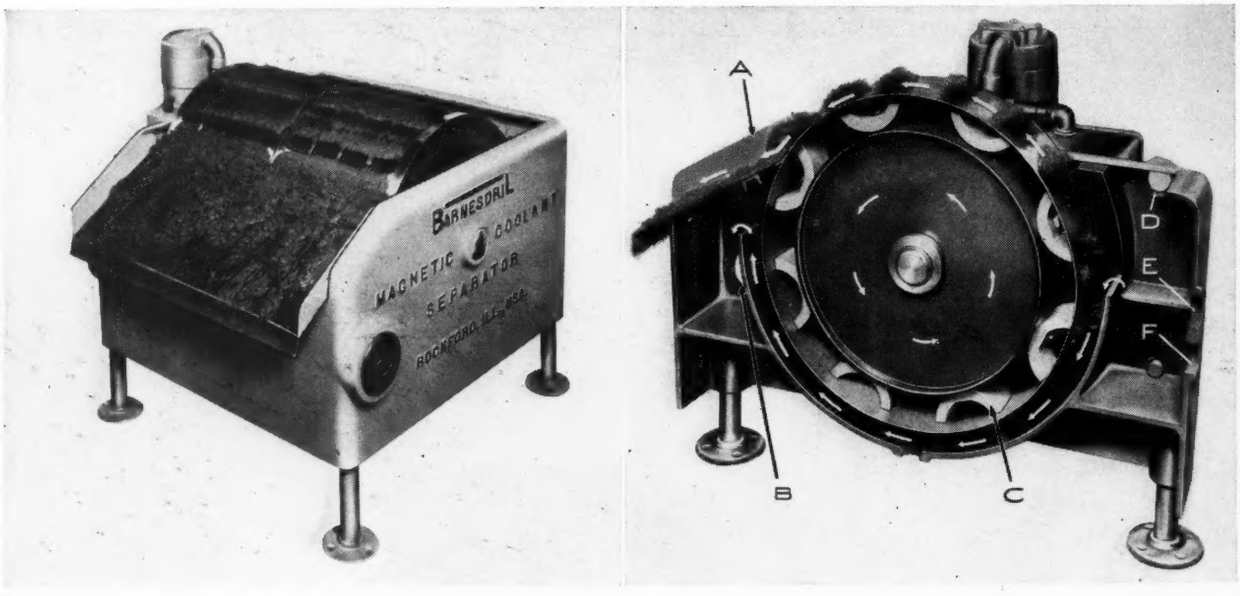
The drum rotates in the opposite direction to the coolant flow, and the magnetic particles are drawn by the magnetic field to the drum shell, where they are held until they are automatically scraped off and deposited in a removable container from the chute *A*. The abrasive fused to the metal particles is attracted to the drum, while the non-magnetic free particles are caught in the filtering mass of magnetically attracted material held in the magnetic field. The pressure inlet *F*, gravity inlet *E*, and overflow pipe opening *D* are shown at the right-hand side of the separator housing, which receives the dirty coolant from the machine. E-79

Rogers grinder for sharpening carbide-tipped circular saws

Rogers Grinder for Sharpening Circular Saws

Samuel C. Rogers & Co., 191 Dutton Ave., Buffalo 11, N. Y., is now building a grinder designed for sharpening any carbide-tipped circular saw from 4 to 20 inches in diameter. This Type SC machine can also be supplied on special order for grinding larger saws. It will take both rough and finish cuts on the top, face, and side of each carbide tip.

The motor-driven grinding wheel is accurately positioned by means of simple, positive controls



(Left) Improved magnetic coolant separator brought out by the Barnes Drill Co. (Right) Cut-away view illustrating operation of Barnesdril magnetic coolant separator

To obtain additional information on equipment described here, use Inquiry Card on page 225.

to provide for any degree of bevel, angle, or clearance desired. The wheel is cross-fed manually to the work over accurately machined slides. A circumference gage is provided to assure grinding all teeth to a uniform height. The saw blade is held securely by large supporting collars on a sturdy bracket. Accurate tooth positioning is maintained by a positive index-plate. E-80

Hand-Feed Turnstile-Bed Turret for South Bend Lathe

A hand-feed turnstile-bed turret is now being made by the South Bend Lathe Works, South Bend 22, Ind., as an accessory for the company's 16-inch swing lathes. This turret is so designed that it can be accurately fitted by the user to the inside of the lathe bed ways, as shown in Fig. 1. It makes possible the economical production of duplicate precision parts, but does not change the basic lathe in any way. The turret can be removed at any time and the tailstock remounted for regular lathe work.

The turret can be locked in position at any point along the lathe bed. The turret ram has stop-screws for each tool position, which index automatically with the head. The turret-head can be back-indexed or spun to skip tool positions. A crank type binder lever is provided for locking the turret-head.

The feed of the turret-slide is 6 1/8 inches, and the distance from center of turret tool holes to top slide is 2 1/2 inches. The head can be bored by the user to take six standard turret tools with 1 1/2-inch diameter shanks. The distance between opposite turret faces is 9 3/8 inches. When properly installed, the turret-head will index to within plus or minus 0.0005 inch, measured 4 inches from the turret face. This accuracy is assured by a superfinished index-pin fitted to a lapped steel bushing.

Accessories for use with the turret include a square turret tool-block and a double tool cross-slide. Either of these attachments will permit using multiple cutting tools. Three can be employed on the double tool cross-slide or four on the square turret tool-block, in addition to the six tools available on the turret head. E-81

"Di-Acro" Deep-Throat Precision Punch

A precision punch of increased throat depth has been added to the line of "Di-Acro" punches made by the O'Neil-Irwin Mfg. Co., 332 Eighth Ave., Lake City, Minn. The 12 1/4-inch throat depth of this punch permits punching to the center of a sheet 24 inches wide. In addition to punching holes of various shapes and sizes, this punch can be employed for a wide variety of blanking, drawing, embossing, and forming operations. It has a capacity for punching holes up to 2 inches in diameter in 16-gage steel plate and holes up to 4 inches in diameter in thinner material.

The throat height is 3 13/16 inches and the hole in the ram is 1 inch in diameter. The punch has a bed 6 by 7 1/2 inches, and weighs 350 pounds. It is especially adapted for use as a companion unit for the 24-inch "Di-Acro" brake and shear. E-82

"Di-Acro" deep-throat punch built by the O'Neil-Irwin Mfg. Co.

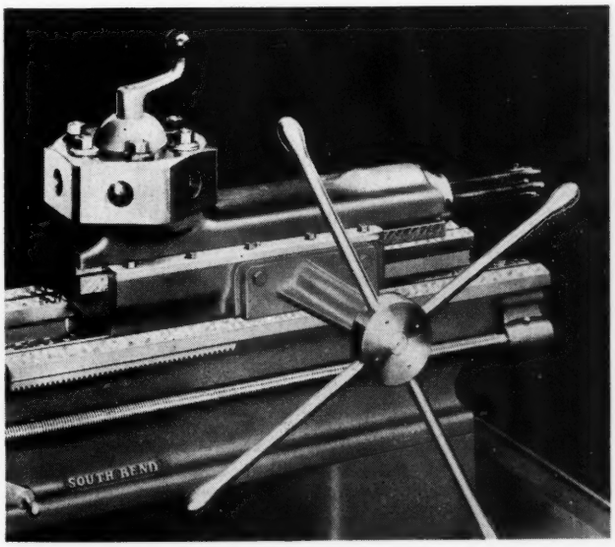


Fig. 1. Close-up view of hand-feed turnstile-bed turret fitted to precision lathe built by the South Bend Lathe Works

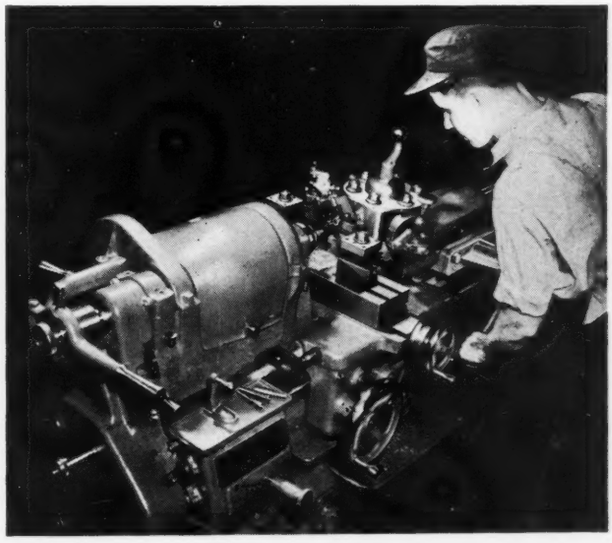
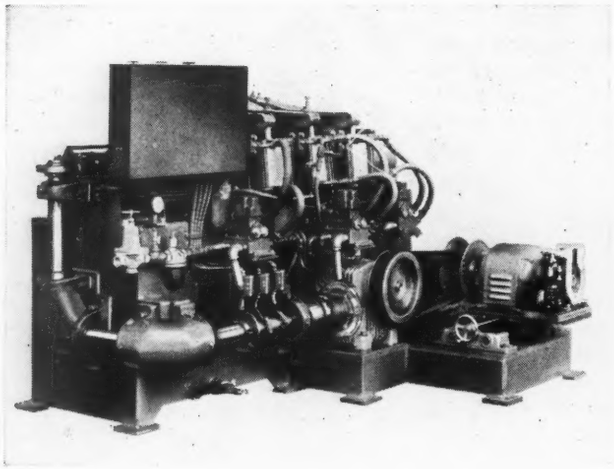
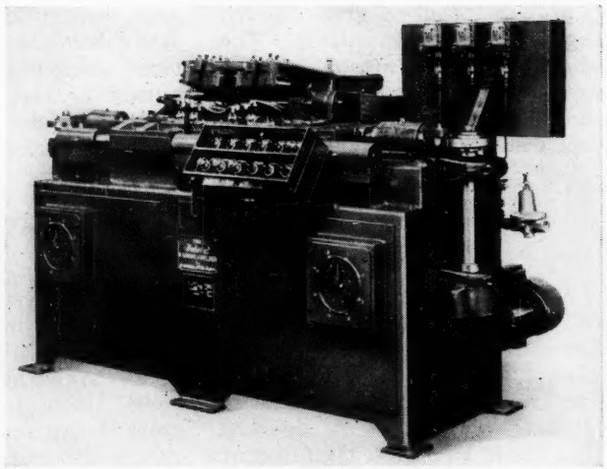


Fig. 2. South Bend lathe equipped with turnstile-bed turret, double tool cross-slide, and hand-lever draw-in collet attachment

To obtain additional information on equipment described here, use Inquiry Card on page 225.





(Left) Rear view of new flash-welder designed by the Federal Machine & Welder Co. for fabricating wringer-roll assemblies. (Right) Front view of flash-welding machine

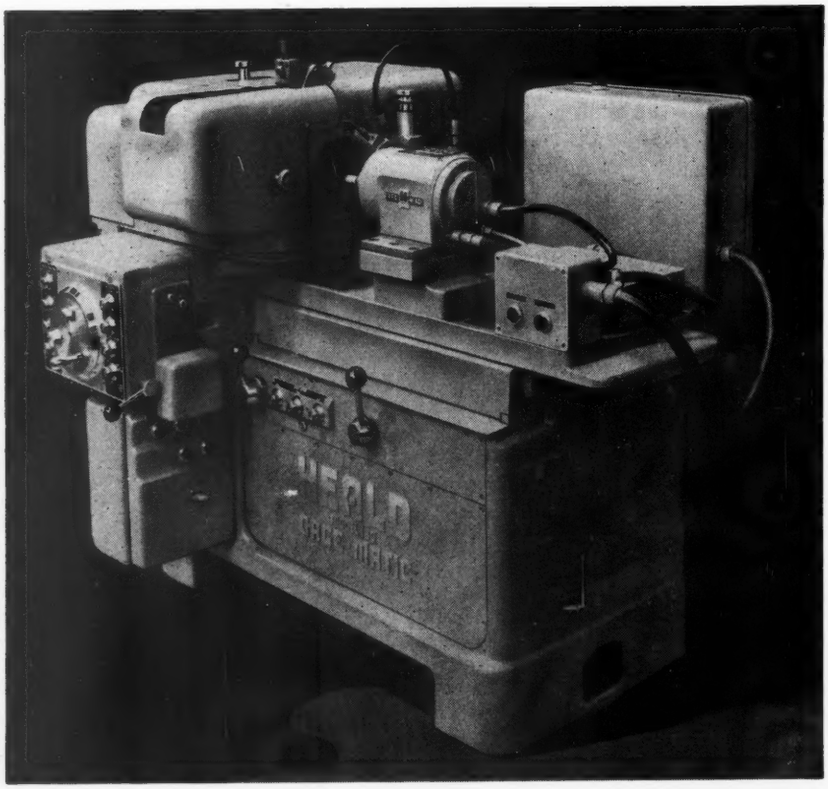
Dual Flash-Welder for Assembling Wringer Rolls

High-speed fabrication of wringer-roll assemblies for washing machines can be accomplished by the use of a heavy-duty 75-KVA dual flash-welder developed recently by the Federal Machine & Welder Co., Warren, Ohio. This new machine is capable of turning out finished parts at the rate of 400 to 450 per hour. It incorporates several outstanding features, including compact drive with 40 to 1 speed reducer; heavy ball-bearing mounted steel shafts with enclosed bevel gears which transmit maximum torque of 3000 inch-pounds from the cone-drive speed reducer to each upset cam; quick acting pneumatic clamping and adjustable self-aligning upper dies having clamping pressure of 7000 pounds; completely automatic machine cycle, except for loading and unloading the parts; and 2-H.P., 1200 R.P.M. motor. E-83

Heald Centerless Internal Grinder Designed for Battery Installation

The Heald Machine Co., Worcester 6, Mass., has placed on the market a new centerless internal grinder designed especially for battery installation. This Model 180 machine features a central hydraulic system. Central coolant supply adaptation as well as central power source for optional "Hi-Frequency" equipment are also available.

When large-volume production is required, these battery type installations have proved extremely profitable. Since the machines are completely automatic, several of them can easily be tended by a single operator, and as all machines in a battery operate from a single central hydraulic power unit, important savings in initial investment, maintenance, and operating costs are obtainable....E-84



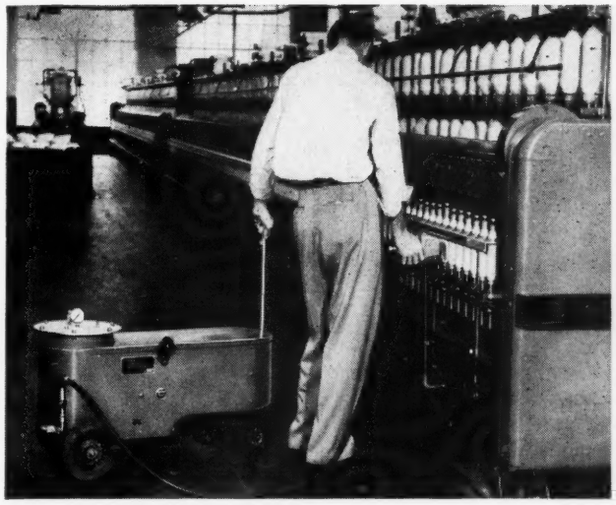
Heald centerless internal grinder adapted for close group installation

Brown Portable Grease Gun

A portable electric grease gun designed for rapid greasing of all kinds of heavy machinery is being manufactured by the Brown Grease Gun Co., Tuckaseegee Road, Charlotte, N. C., and sold by the Brown Distributing Co., Coddington Bldg., Charlotte, N. C.

This grease gun is 23 inches high, 27 1/2 inches long, and weighs 230 pounds when loaded

To obtain additional information on equipment described here, use Inquiry Card on page 225.



Self-contained battery-operated portable grease gun manufactured by the Brown Grease Gun Co.

Welding aluminum car tank plates 1⅛ inches thick on Linde argon metal arc-welding machine

with 25 pounds of grease. It is mounted on rubber-tired wheels. The grease gun is equipped with an electric motor delivering up to 5 H.P., which is operated by a storage battery with built-in charger. About 5000 average fittings can be greased before recharging of the battery is necessary.

Grease from the heaviest to the lightest type can be handled by this gun even under low-temperature conditions. Maximum grease pressure can be adjusted for any nozzle pressure from 500 to 12,000 pounds per square inch. E-85

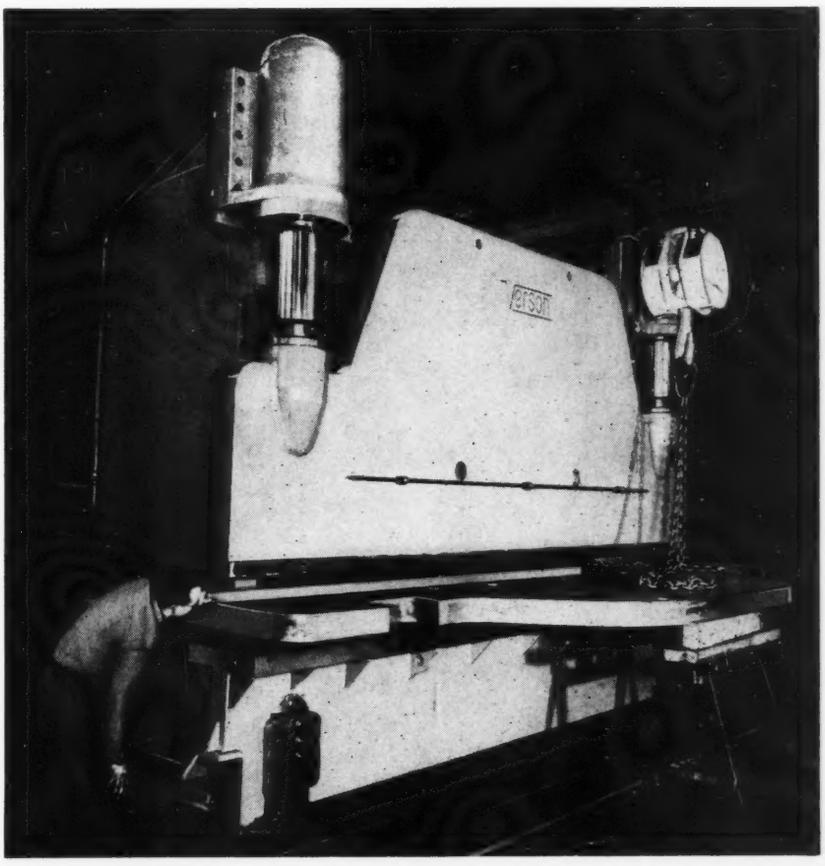
Machine for Argon Metal Arc-Welding of Aluminum

Automatic welding of aluminum by the argon shielded metal arc-welding process can be accomplished on a new machine announced by The Linde Air Products Company, unit of Union Carbide & Carbon Corporation, 30 E. 42nd St., New York 17, N. Y. This machine uses an arc maintained in a shield of argon gas between the consumable filler-metal electrode and the work-piece. The electrode, supplied as a coil of wire, is deposited across the arc into the weld as filler metal. The process is applicable to either machine or hand welding, and can be used for all metals that are readily joined by "Heliarc" welding. This equipment for mechanized welding is known as the Linde FSM-1 machine.

The aluminum alloys now being welded with this machine include 2S, 3S, 52-S, and 61-S in plates 1/4 inch to 1 1/2 inches thick. Almost any thickness can be welded, however, by making a suitable number of passes. E-86

Verson Hydraulic Press Brakes

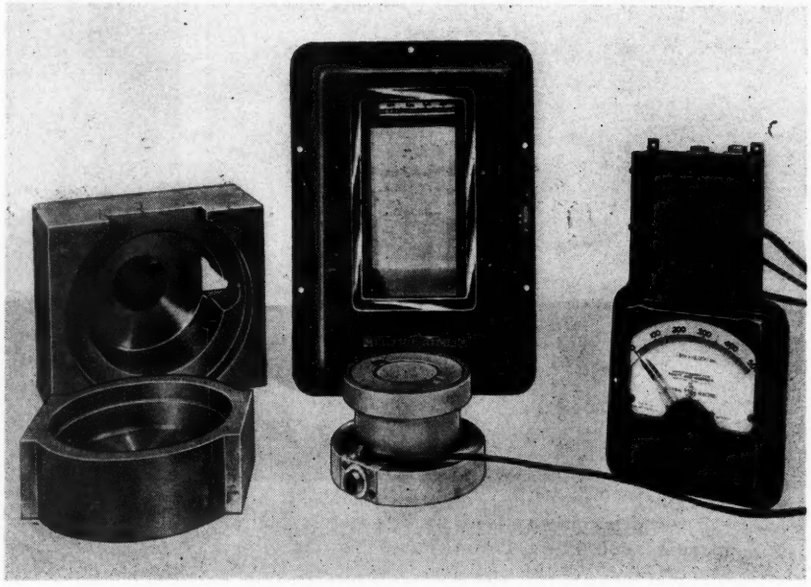
The Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill., has recently added a line of hydraulic press brakes to its regular line of mechanical brakes. The machines in the new line are of streamline appearance and are designed for rapid operation on



Hydraulically operated press brake brought out by Verson Allsteel Press Co.

heavy plate work. They are ideally suited for straightening and for forming to templets in cases where the forming operation requires repeated strokes. Since they are hydraulically operated and cannot be overloaded, they can be safely used for bottoming work.

Other advantages include ability to deliver any predetermined tonnage up to rated capacity; maximum pressure available at any point during stroke; no time lost in setting dies; ability to use all or any portion of stroke; and greater stroke length. The illustration shows an 18-foot 400-ton hydraulic press brake being used to straighten a 6-inch plate. E-87



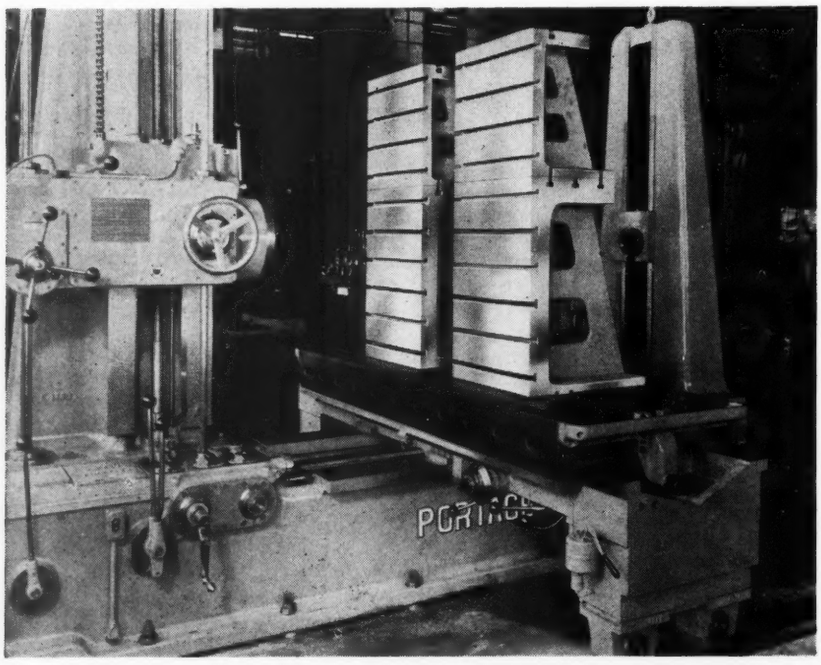
Equipment for measuring rolling pressures on continuous strip mills, announced by Pratt & Whitney

Pratt & Whitney Electrolimit Pressure-Blocks

Pressure-blocks designed for mounting on the housing of continuous strip rolling mills between the top bearing and the screw or between the bottom bearing and the housing for measuring the rolling pressures are a recent announcement of the Pratt & Whitney Division of Niles-Bement-Pond Co., West Hartford 1, Conn. Two gages are required for each mill stand. One is mounted on the drive side and the other on the operating side.

These pressure-block gages are pre-tested on a testing machine such as that used at the Bureau of Standards, and they may be installed as received without further calibration. This pre-calibration permits the pressure-block gage to be moved from one mill to another.

The amount of pressure is determined by accurately measuring the compression of a ring, and this measurement is converted to pounds pressure by the testing machine. A temperature compensator in the gage maintains accurate readings over a wide range. The Electrolimit pressure-block gages are available in capacities ranging from 5000 to 3,000,000 pounds. E-88



Large-size angle-plates brought out by Portage Machine Co.

Large Angle-Plates for Precision Machines

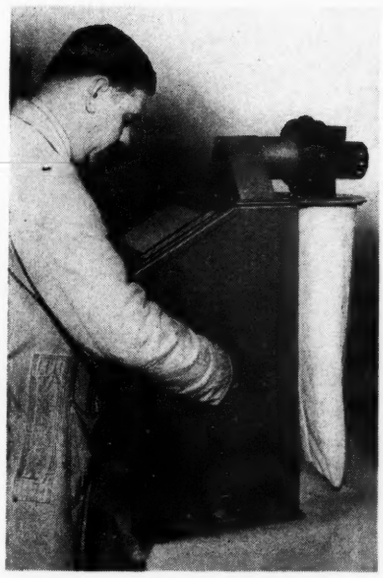
A precision type angle-plate is now being manufactured by the Portage Machine Co., Akron, Ohio, for use on horizontal boring machines, planers, milling machines, and radial drill presses where accuracy in the machined part is of primary importance. The material used in these angle plates is close-grained cast iron, rough-machined, normalized to relieve stress and prevent warping, and then finish-machined on all faces.

These angle-plates are made in two sizes having six and four slots. The base of the four-slot plate is the same size as the top of the six-slot plate, and when bolted to it, provides additional height equivalent to a ten-slot plate. All slots are machined to take 3/4-inch T-bolts. E-89

Bench Blast Cabinet for Cleaning Small Parts

A portable, bench blast-cleaning machine has been developed recently by the W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland 2, Ohio, for abrasive blast cleaning of small parts such as automobile

To obtain additional information on equipment described here, use Inquiry Card on page 225.



Portable, bench blast-cleaning machine made by W. W. Sly Mfg. Co.

pistons, dies, tools, and castings. It is of the cabinet type, and will operate on the compressed air supplied by a standard 5-H.P. two-stage compressor.

The operator loads the parts at the top and observes the work through a window in the hinged cover. His hands are protected by rubber gloves as he rotates the work in the blast stream. A ventilating fan withdraws the dust, which is retained in a removable filter bag. A good view of the work during the blasting operation is made possible by a side-mounted light. The cabinet requires a bench space only 14 by 18 inches. E-90

Hydraulic Press Equipped with Automatic Dial Index-Table

An air-operated, oil-hydraulic press equipped with an eight-station automatic dial index-table has been announced by Hy-Air Products Co., Jackson, Mich.

Automatic cycling is accomplished by energizing an automatic reset timer with a manually operated momentary contact switch. This starts the timer and the down stroke of the press ram. When the preset time has elapsed, the timer de-energizes the solenoid valve controlling the ram, and the ram begins its return stroke. At the top of the stroke, a one-way dog trips a micro-switch connected to the advance side of the index-table cylinder, causing the table to advance to the next position. When this position is reached, a micro-switch on the table is tripped, restarting the timer and beginning the next cycle.

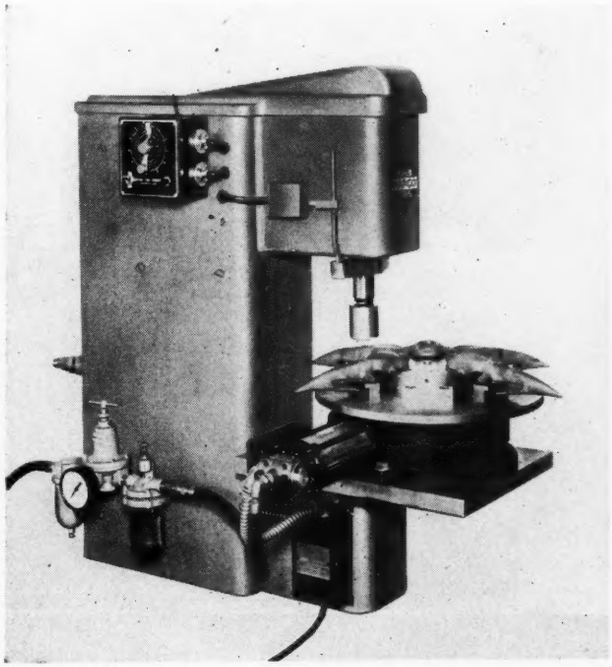
The cycle time can be quickly and accurately adjusted from one to sixty seconds by moving a pointer on the timer dial. The master switch in the electrical circuit can be operated by either hand or foot. Parts are ejected either mechanically or by exhaust air. The press is made in 2 1/2- and 5-ton models with 2- or 5-inch stroke. The pressure, stroke, and speed are all easily adjustable. Index-tables having four, six, twelve, or twenty-four positions are also available, with or without complete tooling. E-91

Pellow Duplex Slotting and Milling Machine

The Pellow Machine Co., 13500 Foley Ave., Detroit 27, Mich., is now manufacturing a duplex continuous slotting and milling machine of similar design to the nut-slotting machine previously introduced by the company. New fixtures and tools developed for this machine make it possible to perform a wide variety of slotting and milling operations, including the milling of square and hexagonal parts.

Three cutting heads are located over each of the two conveyors. This arrangement provides two separate production units, which can be equipped to handle the same or different parts. Provision is made for indexing the work between each cutting station.

The machine will handle round parts up to 1 5/16 inches in diameter, hexagonal parts up to 1 1/4



Hydraulic press with automatic dial index-table, made by Hy-Air Products Co.

Duplex continuous slotting and milling machine announced by Pellow Machine Co.

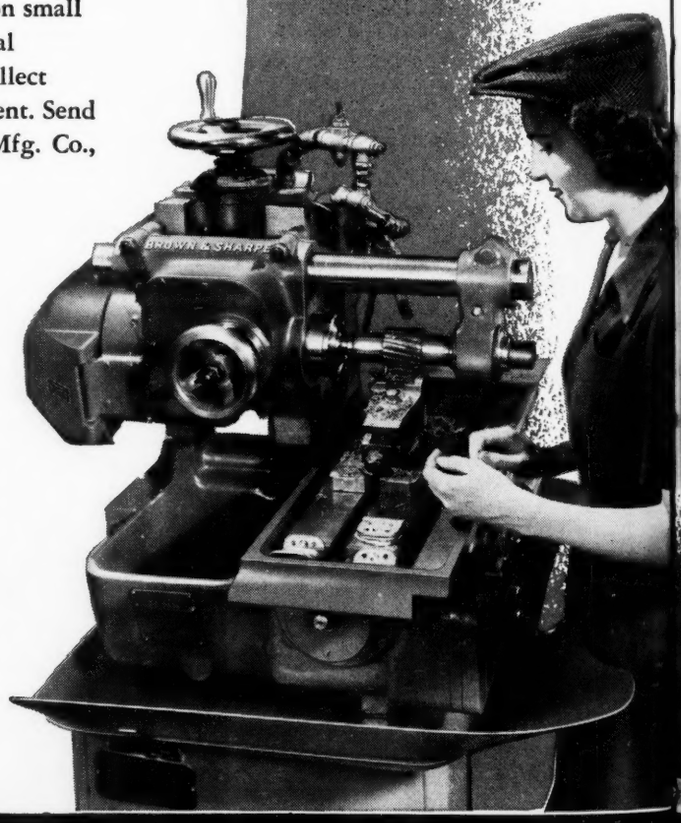
To obtain additional information on equipment described here, use Inquiry Card on page 225.

A "Multi-Dividend" Investment
for production milling of small parts

THIS modern, manufacturing-type milling machine is a glutton for work. It is highly efficient and adaptable to all types of small milling operations. It produces work of consistently-uniform accuracy and finish and operates at an extremely rapid, economical rate. In nearly every plant there are plenty of jobs to keep the Brown & Sharpe No. 000 busy . . . continuously . . . assuring multi-dividends from the investment, over a long period of time.

Get the advantages of low-cost, high quality milling on small pieces such as parts for sewing machines, radios, industrial instruments, business machines and similar products. Collect "multi-dividends" on your investment in milling equipment. Send for the No. 000 illustrated Bulletin. Brown & Sharpe Mfg. Co., Providence 1, R. I., U.S.A.

THE VERSATILE No. 000 PLAIN MILLING MACHINE



No. 000 DIVIDEND FEATURES

for consistent accuracy and finish

- 16 changes of spindle speed, 105 to 3540 R.P.M., suitable for milling a wide range of materials—extra high speed range available.
- 16 rates of feed from 9/16" to 24 3/8" per minute—with full automatic operation.
- Direction of spindle rotation can be set by switch. With intermittent operation, spindle stops when table stops . . . to assure safety in loading.
- Table reversal accurate to .002" . . . particularly advantageous in making blind cuts.

for fast production rate

- Extremely rapid fast-travel movement.
- Work can be safely advanced at fast travel close to cutter.
- Wide range of feeds permits fast efficient milling on a variety of materials.
- Automatic cycle reduces operator fatigue and non-cutting time to minimum — often permits operator to load work with both hands.
- Simple, fast set-ups.

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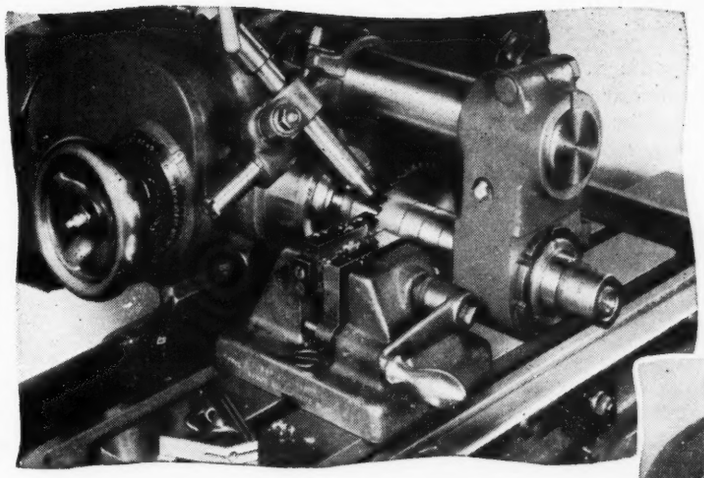
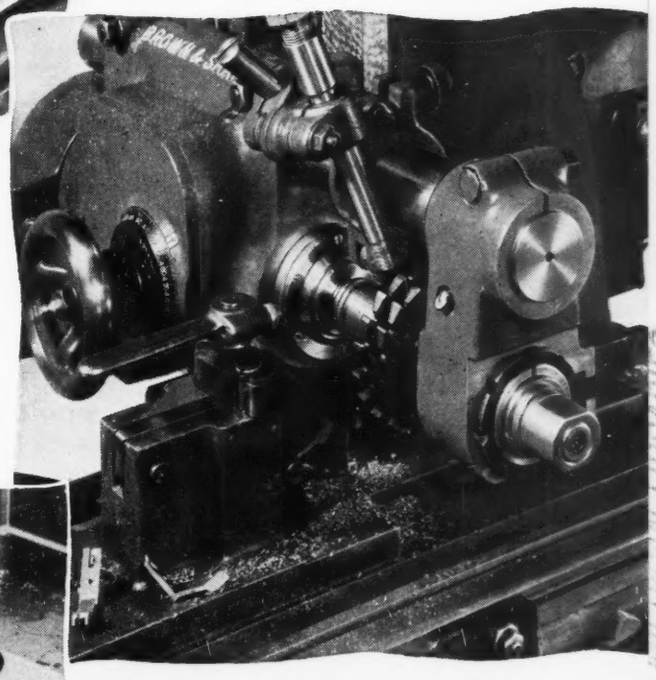


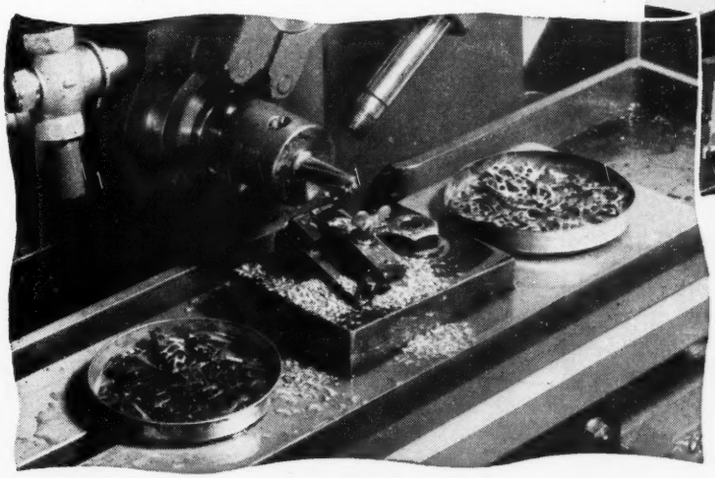
A Dividend of Accuracy ▲

Consistent accuracy of table reversal . . . to .002″ . . . assures uniform depth of slot in this blind cut.

A Dividend of Speed ▼

Rapidity of table movement permits taking light, short cuts practically as fast as operator can load and unload fixture.





A Dividend of Versatility ▲

Broad range of spindle speeds permits efficient use of comparatively large cutters down to the smallest end mills.

SHARPE

B·S

inches, and square parts up to 1 inch. The production rates are 3000 pieces per hour for work under 1 inch in diameter and 2000 pieces per hour for larger parts. The machine requires a floor space of 5 1/2 by 2 feet, is 5 feet high, and weighs 2400 pounds. E-92

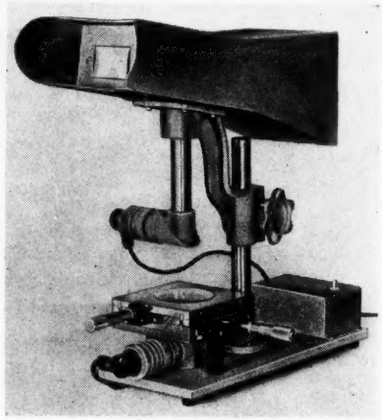
Clearing High-Speed Press

A gain of 70 per cent or more in productive speed while retaining the actual drawing speed of conventional presses was attained recently in a demonstration of the first of the new "HiProDraw" presses completed by the Clearing Machine Corporation, 6499 W. 65th St., Chicago 38, Ill. With this machine, automotive inner door panels were completed in five seconds per piece. When put in service, the press will be equipped with automatic feed and unloader, as shown in Fig. 1, so that it can be operated continuously.

This press is of the mechanical, double-action type. It differs from previous double-action machines in the linkage arrangement that controls the movement of the outer and inner slides. The latter move much more rapidly during the non-drawing portions of the cycle. The physical characteristics of the metal being worked naturally limit the speed of the draw itself, and the new linkage was designed to permit more strokes per minute without tearing the sheet.

Maximum speed for this type of draw has previously been considered seven strokes per minute, while the new machine operates regularly at twelve strokes per minute. The total drawing capacity is 750 tons, of which 450 tons is furnished by the inner, or forming slide. The press measures 108 inches between housings, and will draw a maximum depth of 14 inches. The blank-holder stroke is 22 inches.

The press illustrated is driven by one 75-H.P. motor through a single "Tornadyne" clutch and brake unit. It is equipped with a portable push-button control for one-man operation. E-93



Universal projector brought out by Stocker & Yale

Stocker & Yale Universal Projector

A projector designed for front surface or contour projection (or both at the same time) has been announced by Stocker & Yale, Marblehead, Mass. The instrument is equipped for making micrometer measurements to 0.0001

Fig. 1. Close-up view of "HiProDraw" press equipped with Sahlin "Iron Hand" unloader

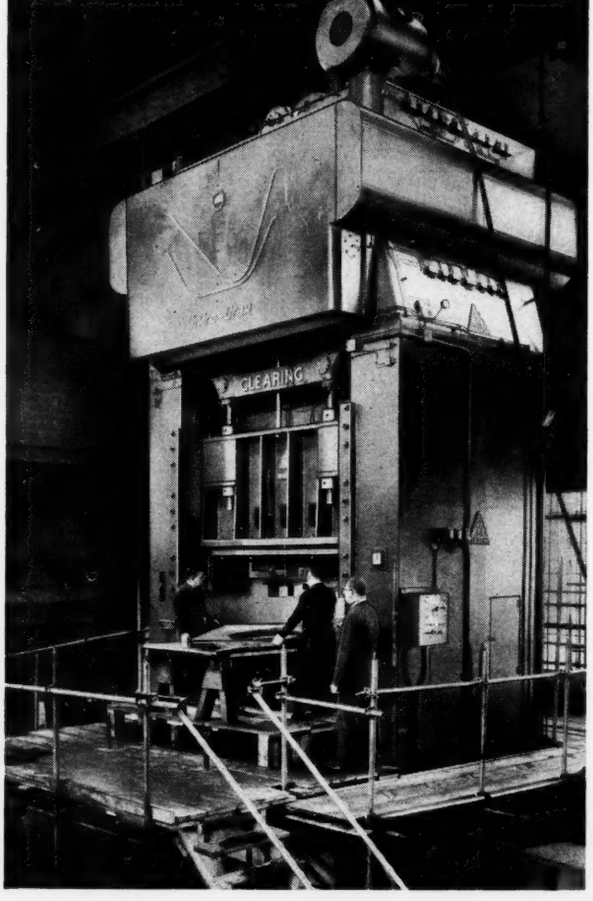
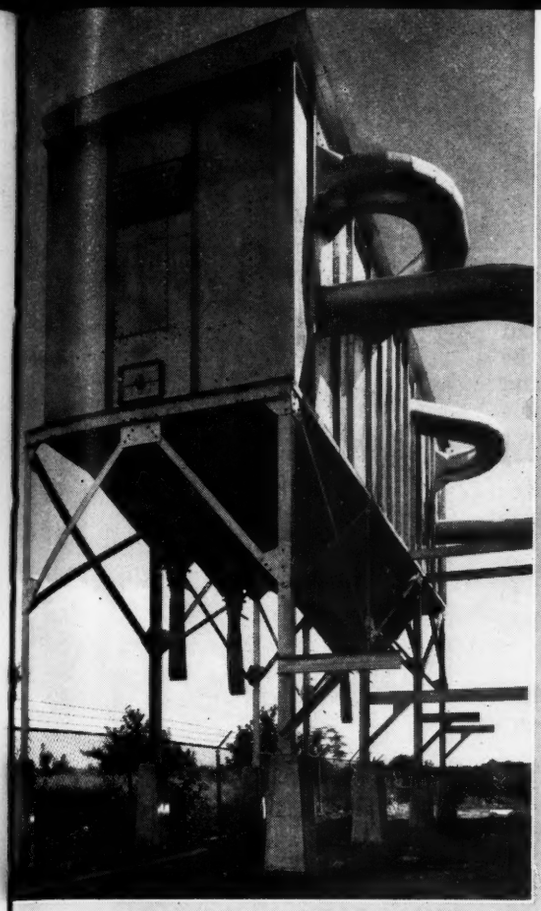


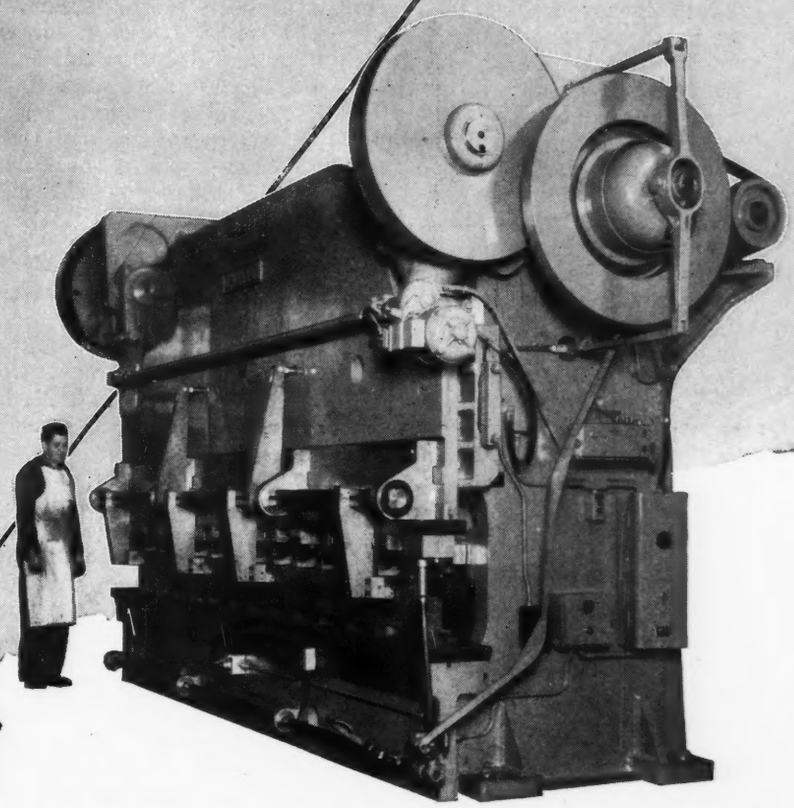
Fig. 2. "HiProDraw" high-speed drawing press developed by Clearing Machine Corporation

To obtain additional information on equipment described here, use Inquiry Card on page 225.



The American Dustube Dust Collector
Photo Courtesy American Wheelabrator and
Equipment Corp., Mishawaka, Indiana.

saved 45 minutes every hour!



"American Wheelabrator" says:

Punching Support Angle

OLD METHOD:

Layout time—three hours to layout 12 holes in each 50 angles.

Punching time—25 pieces an hour total punching time, 2 hours for the 50 pieces.
Total time—5.0 hrs.

CINCINNATI METHOD:

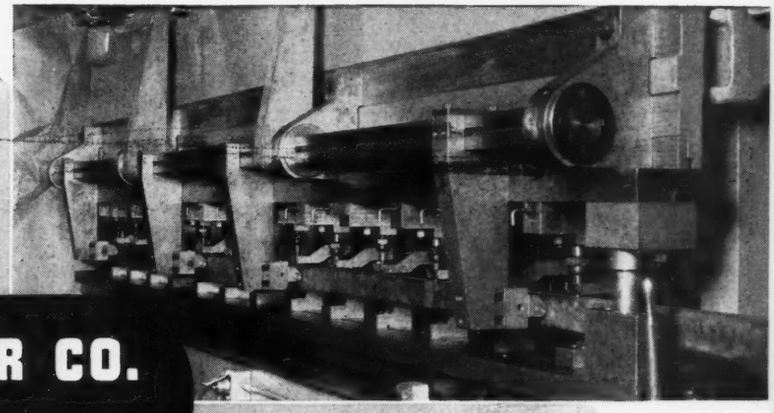
Layout time—none.

Punching time—1 1-10 hours to punch 50 pieces.
Total time—1.1 hrs.

Substantial cost reductions per piece have been effected in the punching of structural channels ranging from 3" to 8", and angles up to 5" x 5" on this 120 Series 12' Cincinnati All-Steel Press Brake. This entire range of work is handled with two sets of quickly interchangeable punching blocks.

Location and spacing of holes are maintained accurately throughout all operations with substantial reduction in subsequent assembly costs.

If you punch, form or bend, write our Engineering Department. They will gladly cooperate in lowering the cost per piece in your shop.



Pneumatic clamps automatically hold the work accurately in position. The adjustable center punching blocks give many combinations of spacing and number of holes.

CINCINNATI

Write for Press Brake Catalog B2A

THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

inch in two planes at 90 degrees to each other. It is available in five standard magnifications from 10X to 60X and in any special magnification up to 120X.

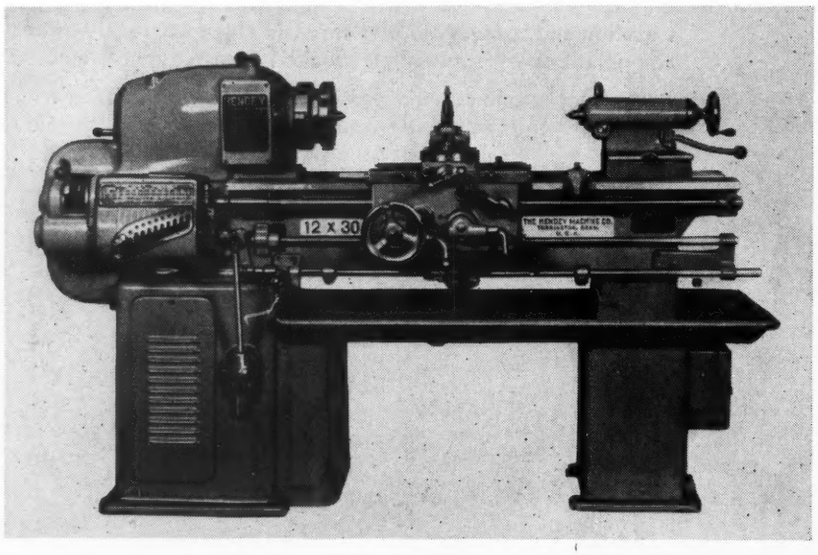
The Textolite screen is 6 inches square, and has single vertical and horizontal cross-lines. Additional lines can be easily scribed as required. The measuring stage is 5 inches square and will take parts up to 5 inches in height. It has a travel range of 1 inch. A front surface illuminator is used to project, by means of reflection, such parts as dies, stampings, form tools, etc. An important application is the studying of the movements of inaccessible components of mechanisms.

The contour illuminator will project a shadow image for checking tooth form, pitch, and similar elements of screws, taps, gears, hobs, etc. The projector is 20 inches high, 11 inches wide, and 20 inches deep. It weighs 40 pounds. E-94

Hendey General-Purpose Lathe

The Hendey Machine Co., Torrington, Conn., has developed a new No. 1 model, general-purpose lathe to replace the old 12- and 14-inch "Tie-bar" cone-head lathes. This lathe will be available in sizes of 12 by 30 inches, 12 by 42 inches, and 12 by 54 inches, all with a maximum swing over the ways of 14 1/2 inches.

Although low in cost, the new machine incorporates many of the latest Hendey features, including induction-hardened and precision-ground bed ways. The spindle is mounted in precision pre-loaded ball bearings, and is driven by five V-belts. Speeds are selected by a single-lever belt shifter from four-step cones mounted on the 3-H.P. reversing motor shaft and on the jack-shaft. The spindle speeds—30 to 1142 R.P.M.—cover the range necessary for carbide tools and fine work finish. There are thirty-six thread-cutting feeds for cutting from 1 1/2 to 80 threads per inch, and thirty-six turning feeds from 0.0031 to 0.1666 inch per revolution..... E-95



General-purpose lathe with hardened and ground bed ways built by the Hendey Machine Co.

Improved Heavy-Duty "Ace" Tool and Cutter Grinder

The Oliver Instrument Co., 1410 E. Maumee, Adrian, Mich., has announced a major improvement in the construction of its heavy-duty "Ace" tool and cutter grinder. The improvement consists of mounting the horizontal ram on a series of 3/4-inch balls contained in hardened and ground steel tracks. The unit is rigidly confined and the balls cannot move in any but a predetermined path. A patented spring pressure arrangement keeps the balls and track under constant pressure to compensate for any wear that may occur. With this construction, friction has been practically eliminated and the life of the machine greatly increased.

Ease of set-up and simplicity of operation are outstanding features of this machine. Only two fixtures are required to handle the standard range of milling cutters, including end-mills, side-mills, spot-facers, angular cutters, dovetail cutters, small face mills, formed cutters, special tools, and other cutters used in the average machine shop.

Oliver "Ace" tool and cutter grinder of improved design

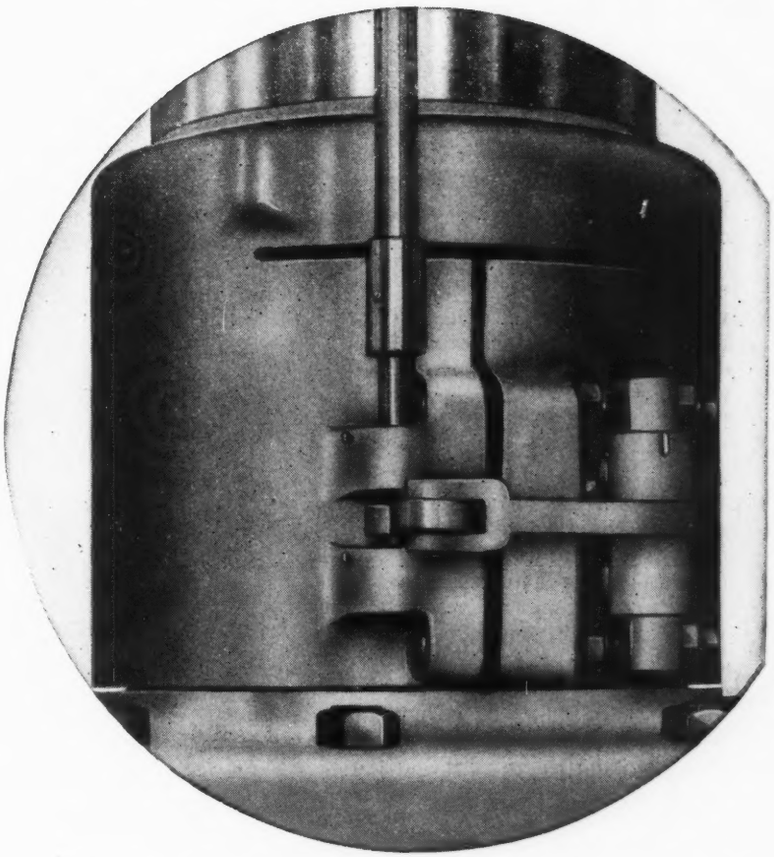
In grinding cutters on this machine, the ball-mounted horizontal ram that carries the grinding wheel spindle is moved across the work. This method has been developed to speed up set-ups, indexing, and grinding. It permits the operator to feel the cutting action of the wheel and determine when the wheel is cutting with maximum efficiency and accuracy. This results in fewer burnt teeth, reduced grinding time, and more accurate cutters. It requires only 6 ounces of pressure on the operating hand-lever to start the movement of the ram. This means that it actually can be operated by finger touch. The spindle drive, which is now equipped with V-pulleys and a belt, provides three grinding speeds. E-96

Knitted Wire Mesh

Knitted wire mesh produced by knitting any desired metallic wire of diameters from 0.005 to 0.012 inch into pieces from 1 to 7 inches in width is being manufactured by the Letraw Mfg. Co., 229 W.

To obtain additional information on equipment described here, use Inquiry Card on page 225.

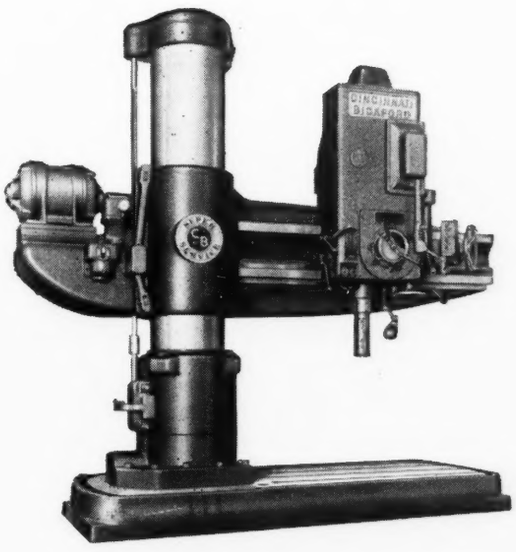
TRIED *and* TRUE



Now, powerful hydraulic arm and column clamping, operated by push buttons at the head, is standard, available on ALL Super Service Radials having column diameters from 11" to 26", inclusive.

This new feature on the smaller radial drills has been applied after many years of development plus 10 years of use on the large 22" and 26" diameter column machines which necessitate the most effective and powerful clamping that can be devised.

Step saving controls, all centralized on the SUPER SERVICE "clearview" head decrease machine handling time and increase accuracy and production.



Equal Efficiency of Every Unit Makes the Balanced Machine

Column clamping mechanisms are many and varied in design, but no other assures maximum power and effectiveness by providing;

1. The double draw bolt acting on hardened eccentrics.
2. Simple trouble proof hydaulically actuated clamp.
3. Push button controlled at the head on all of the SUPER SERVICE radial drills from the 11" diameter column to the 26" diameter column machines inclusive.
4. Uninterrupted column sleeve clamping surface is an integral part of the column sleeve, permitting stronger sleeve construction.
5. Stress proof column sleeve clamping area.
6. Less movement to the arm when clamp is actuated.

For further information on the distinctly superior engineering features of the SUPER SERVICE radial, write for booklet R-29 covering the 11" to 19" diameter column machines, and Booklet R-22 on the 22" and 26" diameter column machines.

RADIAL AND UPRIGHT SUPER SERVICE DRILLING MACHINES

THE CINCINNATI BICKFORD TOOL CO. Cincinnati 9. Ohio U.S.A.

Illinois St., Chicago 10, Ill. The mesh is either flattened or round, and may be crimped in continuous lengths. In this form, it can be cut and rolled to specifications for use in the manufacture of industrial air filters for automobiles, trucks, locomotives, etc. E-97

Baldwin Strain Indicator

The Baldwin Locomotive Works, Philadelphia 42, Pa., has brought out a portable, direct-reading battery-powered strain indicator for use with SR-4 R bonded resistance wire strain gages. The new Type L indicator is an improved model of the previous Type H instrument. An increase has been made in the 0.0001-inch steps from 1000 to 2000 micro-inches per inch per step, giving a total of 20,000 micro-inches per inch. This results in greater convenience of operation and minimizes the use of the "range extender" switch. The range extender has also been increased from an approximate 10,000 micro-inches to a more exact 20,000 micro-inches with an accuracy of plus or minus 50 micro-inches. This change extends the balancing range of the instrument to plus or minus 30,000 micro-inches.

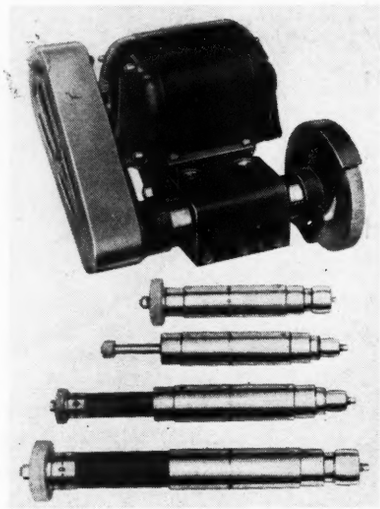
Another new arrangement permits the use of the instrument with a completely external Wheatstone bridge circuit without modifying the internal circuit. Also, an oscilloscope connector jack is provided for applications in rephasing problems sometimes encountered when using extremely long leads, say, from 50 to 100 feet between SR-4 strain gages and the instrument. The new strain indicator is 6 by 9 by 12 inches, and weighs about 25 pounds. E-98

Improved strain indicator brought out by Baldwin Locomotive Works

Maxwell Precision Grinder Spindles and Grinders

The Maxwell Co., 420 Broadway, Bedford, Ohio, has announced a new line of precision grinding spindles for use on all standard type grinders. These spindles are equipped with Fafnir bearings throughout, and are designed for high-speed precision grinding.

The uppermost spindle shown in the illustration, designated Type H, is designed especially for external grinding. The three lower spindles, Types H-3, H5-1 1/2, and H5-2, are intended for internal grinding. All the spindles have the same body diameter of 2 1/8 inches. This dimension can be varied, however, to meet the mounting requirements.



Maxwell precision grinder and interchangeable spindles

Spindle H has a grinding speed of approximately 3450 R.P.M., while the other three types can be operated at speeds up to 30,000 R.P.M. to meet individual requirements. Any of these spindles can be furnished as standard equipment on the new Maxwell Type HE precision grinders, which are designed for attachment to engine lathes, planers, boring mills, etc. The new grinder is driven by a 1/2-H.P. totally enclosed motor, which operates on 110- to 220-volt single-phase 60-cycle current. E-99

Set of "Xpand-O-Lap" lapping tools brought out by Ideal Industries, Inc.

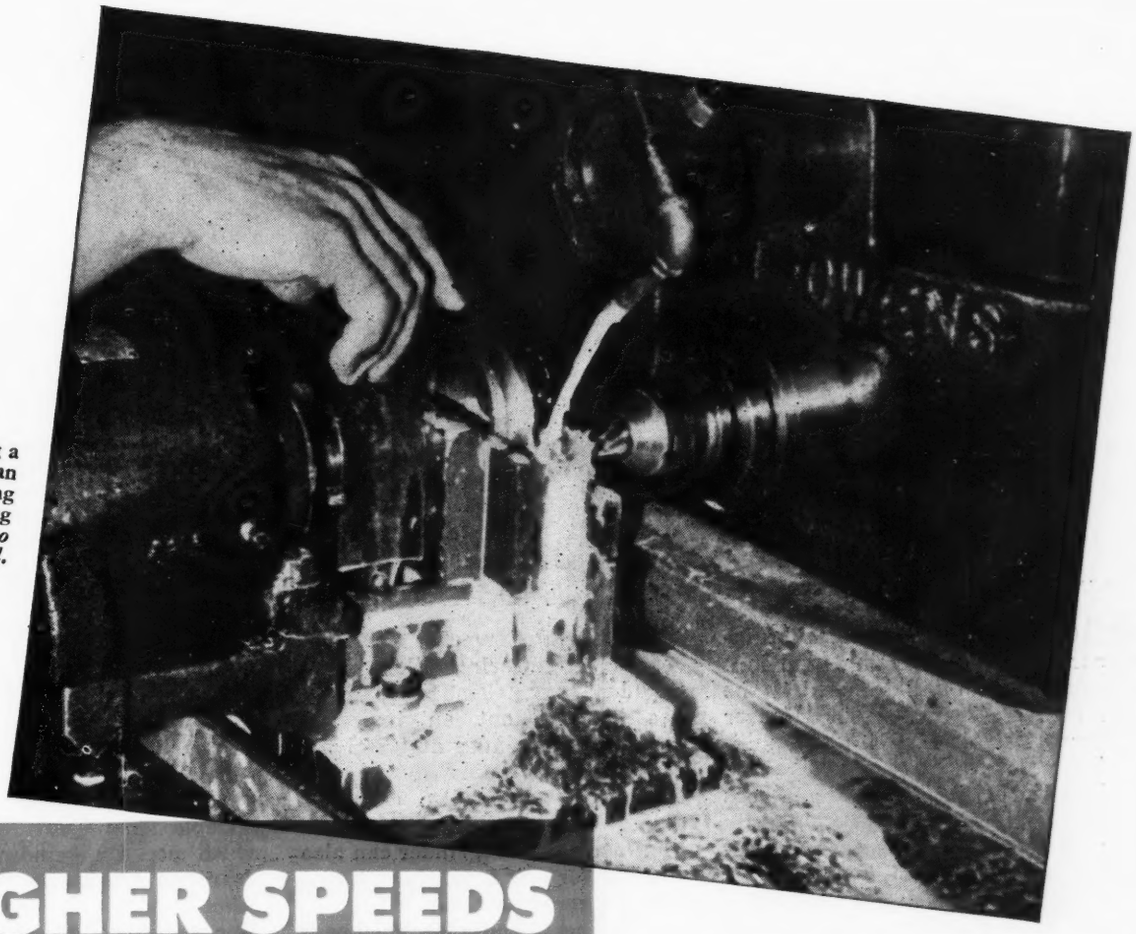
Ideal "Xpand-O-Lap" Lapping Tool

Ideal Industries, Inc., 1011 Park Ave., Sycamore, Ill., announce a self-aligning, self-adjusting lap of unique design that provides a constant self-expanding pressure between the lap sleeves and the work. This new "Xpand-O-Lap" requires no manual adjustment. It consists of one steel arbor, two serrated copper sleeves, and one S-shaped pressure spring. The spring applies constant, even pressure against the two sleeves. Diagonal grooves in the sleeves serve as channels for the lapping compound to assure uniform distribution, making lapping faster and smoother and eliminating galling or seizing.

The "Xpand-O-Lap" arbors last longer because they have no setscrew to wear or possibly "freeze" and break off under heavy duty and frequent adjustments. The only servicing these tools need is the occasional replacement of the sleeves or pressure spring, which takes only a few seconds. Pressure springs are of specially tempered steel to maintain unvarying pressure for long periods.

Available in sets of six laps or individually. A complete set with stand consists of the following sizes: 1/8, 3/16, 1/4, 5/16, 3/8, and 1/2 inch. Two extra sets of sleeves and one extra spring are included for each lap. E-100

To obtain additional information on equipment described here, use Inquiry Card on page 225.



Milling a free-way in an inner ball bearing race. The cutting coolant is *Texaco Soluble Oil.*

HIGHER SPEEDS LOWER COSTS ASSURED when you use Texaco cutting fluids

Take the word of experienced operators everywhere for this fact: whatever metals you are cutting, whatever machining operations you are performing, you'll increase your output and reduce your costs by using *Texaco Cutting, Grinding and Soluble Oils.*

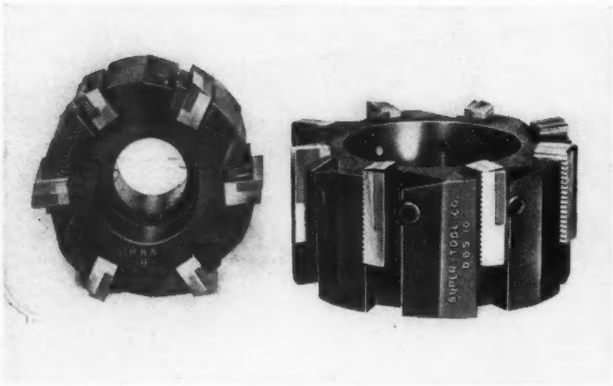
With the right *Texaco Cutting, Grinding and Soluble Oils* on the job, you can machine faster, improve finish and reduce rejects. At the same time, you'll get more cuts per tool grind, longer tool life . . . you'll prevent chip welding or wheel loading . . . save production time and materials.

Let a Texaco Lubrication Engineer specializing in cutting fluids help you select the proper *Texaco Cutting, Grinding and Soluble Oils* for best machining results. Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N .Y.

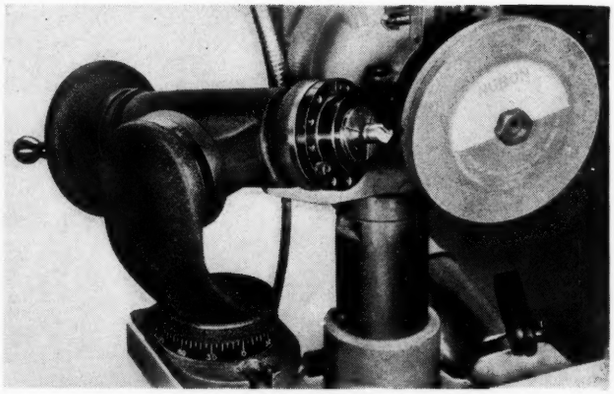
TEXACO

TEXACO CUTTING, GRINDING AND SOLUBLE OILS FOR FASTER MACHINING

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE on television every Tuesday night. See newspaper for time and station.



Carbide-tipped inserted-blade end-mill made by Super Tool Co.



Relief grinder for relieving countersinks and small cutters

Carbide-Tipped Shell End-Mill

Carbide-tipped replaceable inserted blades are being used in a new shell end-mill designed by the Super Tool Co., 21650 Hoover Road, Detroit 13, Mich., for milling cast iron, brass, etc. The carbide-tipped serrated-back blades are firmly held and can be easily adjusted. Sturdy construction insures maximum rigidity at high table feeds. The new end-mills are made to standard specifications in 3-, 4-, 5-, and 6-inch diameters, right-hand only, with the number of blades equal to twice the diameter of the cutter. E-101

Relief Grinder for Small Tools and Cutters

The Angle Computer Division, S & D Engineering Co., 1709 Standard Ave., Glendale 1, Calif., has brought out an improved model relief grinder designed for rapid relief grinding of right- or left-hand countersinks, center drills, integral-pilot cutters, and pilot drills. This grinder can also be used for any type of small tool cutter grinding, such as the sharpening of end-mills, shell end-mills, spot-facers, small milling cutters, and machine reamers, as well as for backing off thread cutting taps.

It fits any standard grinder, and has been redesigned so that the working head can be set in any desired position in order to facilitate various cutter grinding operations. Work from 1/16 to 1 inch in diameter can be handled with this new equipment, using standard collets.

The lift of the single cam is variable from 0.001 to 1/8 inch, which permits grinding rake or clearance angles, in addition to relief. Special built-in indexing pins provide for rapid accurate grinding, and adjusting pins permit the grinding of cutters with one, two, three, four, six, and twelve flutes. E-102

"Rayotube" Designed for Quick Sighting

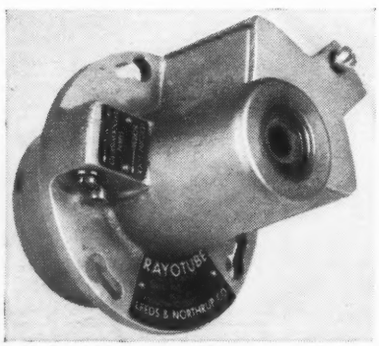
New "Rayotube" featuring quick sighting and stability in drafts and hot spots. Built to work with all "Micromax" and "Speedomax" Rayotube radiation pyrometry instruments brought out by the Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa. This new detector is designed for easy application to such equipment as slab furnaces, soaking pits, open-hearth furnaces, ceramic kilns, and wherever operating conditions are severe. E-103

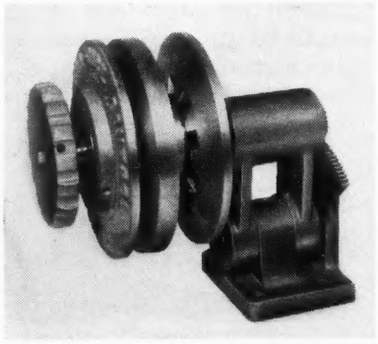
Variable-Speed Control with Locking Device

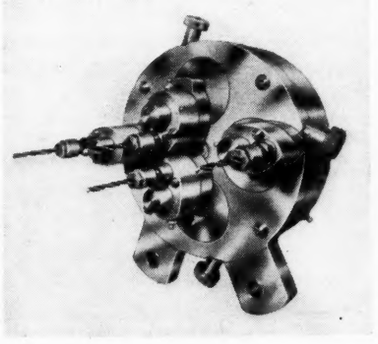
"Fra-Sure" variable-speed transmission for fractional-horsepower motors, announced by Frazier & Son, 338 Cortlandt St., Belleville, N. J. This equipment enables the rate of speed to be easily changed and set by a simple knob movement. The automatic speed locking device which keeps the pulley in the desired position throughout the entire 3 to 1 ratio insures maintenance of the selected speed. Remote control is available if desired. E-104

Errington Adjustable Drill Head

Fully adjustable drilling head announced by the Errington Mechanical Laboratory, Inc., Staten Island 4, N. Y. Can be used for drilling holes in square, rectangular, circular, triangular, or irregular patterns, and is light and compact. Grooved ball thrust bearings are provided on all spindles, and needle bearings are used wherever possible. All moving parts are hardened. There is a simple finger-tip locking arrangement. Made with three, four, and six spindles,





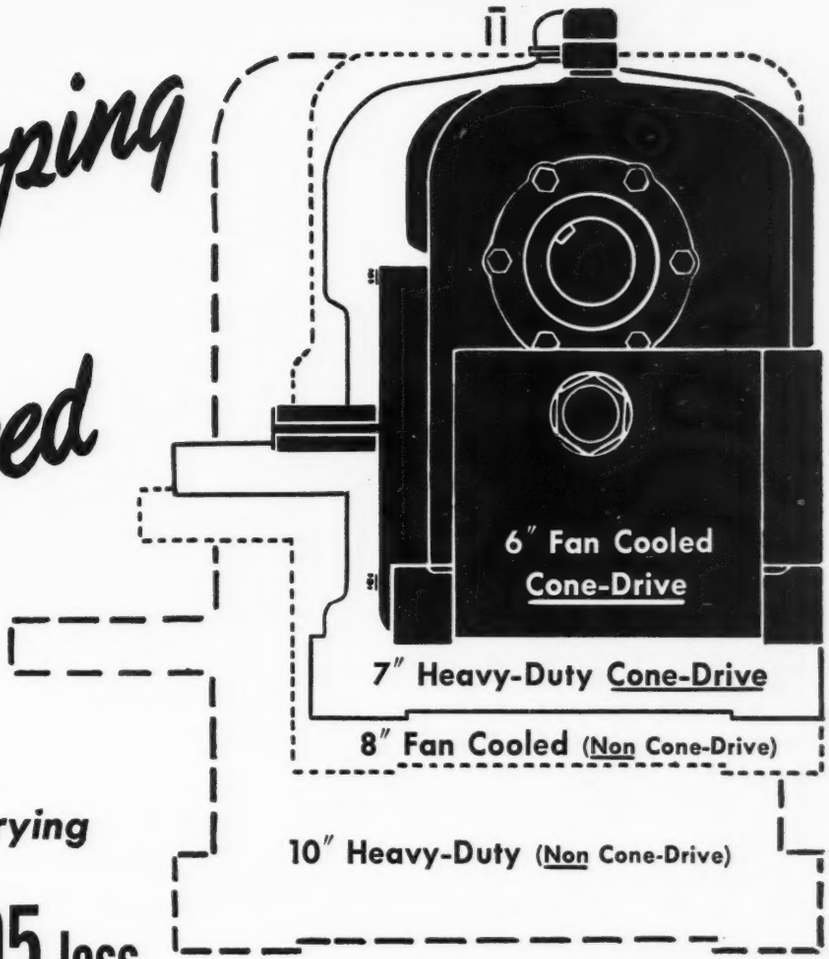


To obtain additional information on equipment described here, use Inquiry Card on page 225.

Example { 5½ hp at 870 rpm; 60 to 1; Class 1 service

Here's what Cone-Drive double-enveloping gears save you in speed reducers*

To handle this load would call for one of these



For the same load carrying capacity:

8″ Fan Cooled Non-Cone-Drive costs . . $95 less

7″ Heavy-Duty CONE-DRIVE costs . . $113 less

6″ Fan Cooled CONE-DRIVE costs . . $257 less

*—Based on approximate resale prices, Jan. 1st, 1950

. . . and similar savings on gear sets

Cone-Drive Gears and Reducers handle more load—cost less, due to Cone Drive's double-enveloping gearing.

In Cone-Drive you can also get the triple benefits of

Standard gears
Standard housings
Standard fan-cooled attachments

CONE-DRIVE GEARS

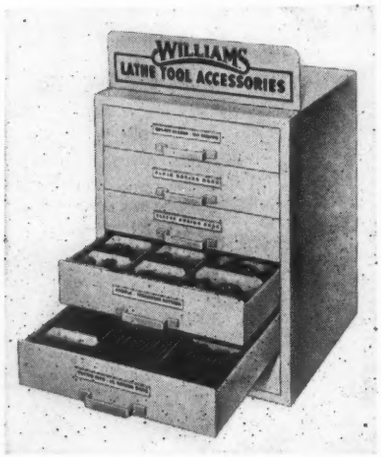
CONE-DRIVE GEARS

DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS

Division, Michigan Tool Company

7171 E. McNichols Road • Detroit 12, Michigan

and in sizes from 0 to 1/4 inch; from 3/16 to 1/2 inch; and in No. 2M.T. socket capacity. E-105

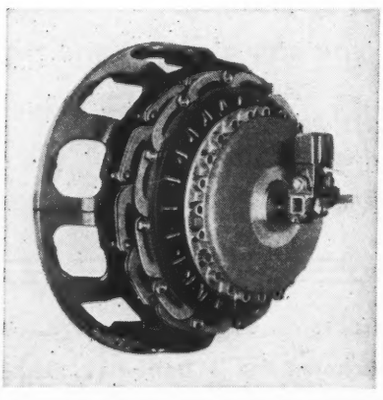


Williams Lathe Tool Accessory Cabinet

Cabinet and assortment of lathe tool accessories, including high-speed cutters, cutting-off blades, formed cutters for threading tools, sleeve and plain bars, light boring-bars, knurls, and set-screws for tool-holders. The contents of each drawer are identified outside, as well as inside. A label on each compartment gives the name and size of the accessory contained therein. The cabinet is made of heavy gage welded steel, and measures 18 1/4 by 14 5/8 by 14 1/8 inches. Total weight, including contents, is 74 pounds. Made by J. H. Williams & Co., 400 Vulcan St., Buffalo 7, N. Y. E-106

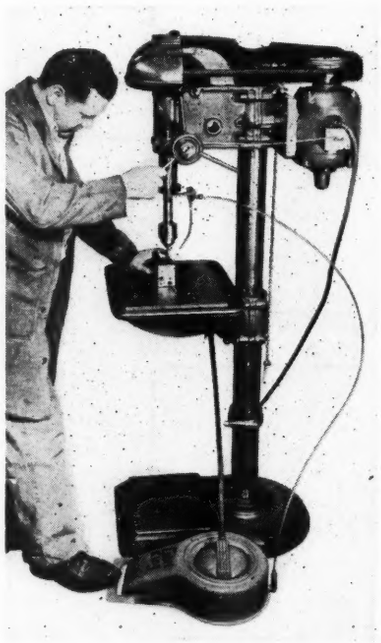
Air-Operated Friction Clutch-Brake

Improved type of friction clutch-brake for punch presses, power shears, and "start-stop" operations in general, placed on market by Industrial Clutch Corporation, Waukesha, Wis. This "Flex-Disc" clutch-brake is operated by air at shop line pressures through an electric solenoid valve with push-button control. Improved heat dissipation is the principal advantage claimed for this new equipment. A complete range of sizes, with outside diameters ranging from 8 1/4 to 35 inches and torque capacities from 3660 to 578,000 pounds-inch, is available. E-107



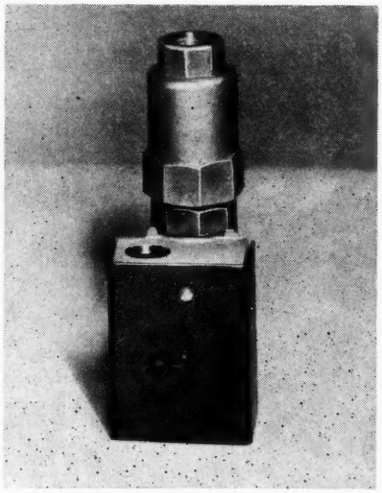
Foot-Controlled Coolant Supply Unit

Coolant supply unit for use on drill press, tapping machine, milling machine, or bench. This "Lubri-King" unit has recently been introduced by the W. A. Horejsi Co., Department M, 2001 James Ave. N., Minneapolis, Minn. It consists of a heavy steel tank holding approximately two gallons of lubricant or coolant, equipped with a foot-operated pump, plastic hose, and nozzle attachment with bracket that can be quickly attached to a machine. The foot-pedal on the pump controls the amount of fluid delivered to the cutting tool. E-108



Electric Control Operated by Water Flow

New control device actuated by a flow of cold water which can be used to open or close an electrical contact. Announced by General Electric Co., Schenectady 5, N. Y. This new device, called a "flow interlock," closes a contact when a flow of water exceeds a preset amount, and opens it when the flow falls below the preset amount. Thus it acts as a fuse in a circuit which depends upon water cooling for protection. It can be used in hot water heaters and welding units and for transformer cooling, induction heating, television luminaires, water-cooled dynamometers, etc. Can be adjusted to control the circuit for any flow from one to four gallons per minute. The electrical rating of the device is 10 amperes at 125 volts, 5 amperes at 250 volts, and 3 amperes at 460 volts, alternating current. Maximum line pressure that the flow interlock will withstand is 125 pounds per square inch.....E-109



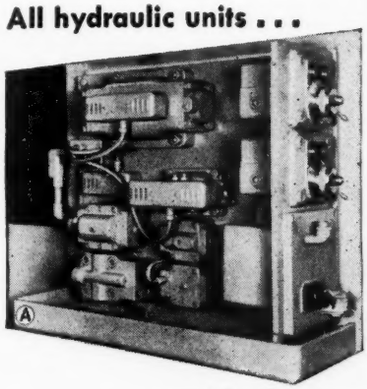
Chronolog Designed for Production Control

New Model C-1 Chronolog manufactured by the National Acme Co., 170 E. 131st St., Cleveland 8, Ohio, and recently introduced by this company's representative, Chronolog, Inc., National Bank Bldg., Detroit 26, Mich. The Chronolog is a patented, electrically operated unit, which produces a printed record of machine production and idle time. It furnishes an accurate printed record of the number of pieces produced, the reasons for any idle time and its duration, as well as the reasons for other production delays. Causes of discrepancies between rated efficiency and actual machine performance are immediately available from the Chronolog tape, either during operations or at the finish of a job or work shift. From these records, it is easy to determine what corrective steps are needed. E-110

To obtain additional information on equipment described here, use Inquiry Card on page 225.

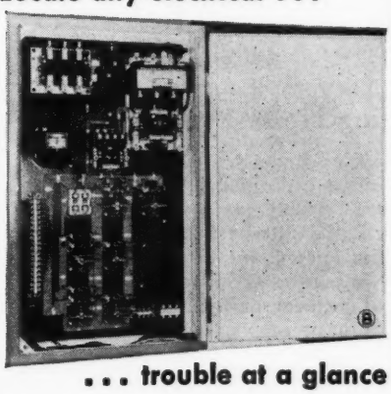
MACHINE TOOL SCOOP!

All hydraulic units . . .

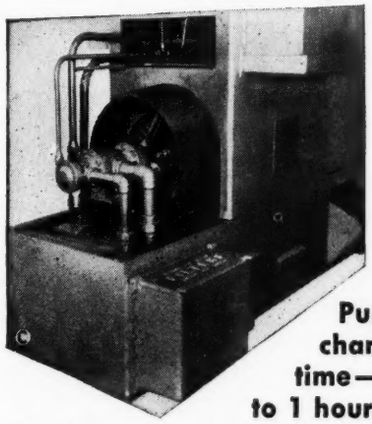


. . . out in the open

Locate any electrical . . .

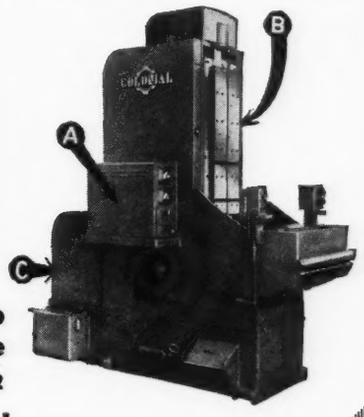


. . . trouble at a glance



Pump change time—½ to 1 hour. . .

Quickly replaceable Filter Units



Colonial Broaching Machines BEAT J.I.C. Standards!

Colonial broaching machines—SINGLE and DUAL RAM for surface broaching, PULL-DOWN and PULL-UP for internal broaching—not only meet J.I.C. standards but actually GO ONE STEP FURTHER.

Colonial has added interchangeability of components—*hydraulic, mechanical and electrical.*

The combination of these two steps ahead in broaching machines—J.I.C. standards and standardization and interchangeability of components—also means that STANDARD Colonial machines can be adapted with amazing ease to all kinds of AUTOMATION:

- **. . . automatic loading and unloading**
- **. . . hopper and magazine feeds**
- **. . . automatic indexing and clamping**
- **. . . mechanical and electrical interlock with other machines (for automatic transfer of work between machines)**

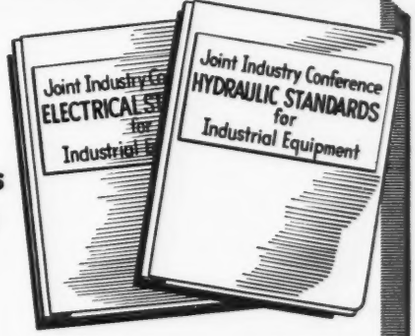
We will be glad to send you descriptive bulletins on these machines.

PIONEERS OF H.S.S. BROACHING

COLONIAL

BROACH CO. DETROIT 13

J.I.C. Standards were set up as a goal



. . . by the Joint Industry Conference of major users and manufacturers of machine tools and accessory equipment. Covering hydraulic and electric operation, they set forth what is IDEAL machine design to insure absolute MINIMUM DOWN-TIME, and MAXIMUM ACCESSIBILITY and SERVICEABILITY of operating units, plus MAXIMUM OPERATOR SAFETY.

When buying ANY kind of machine tool, it will pay you to check how close its design comes to meeting these standards.

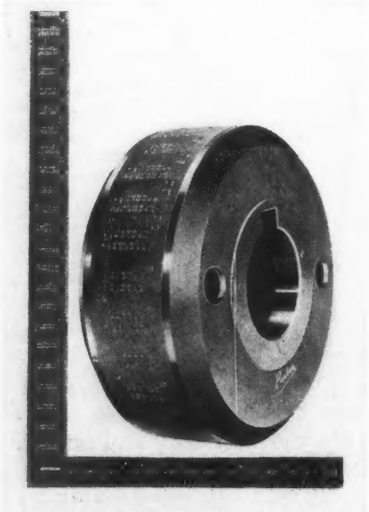
"Skil" Portable Drill with "Lamb" Handle

Heavy-duty 1/4-inch drill made by Skilsaw, Inc., 5033 Elston Ave., Chicago, Ill. This drill has a "Lamb Wedge Lock" handle developed to lessen operator fatigue while providing for fast continuous drilling. It fits either the right or left hand, and does not crowd the fingers. The drill is 7 1/2 inches

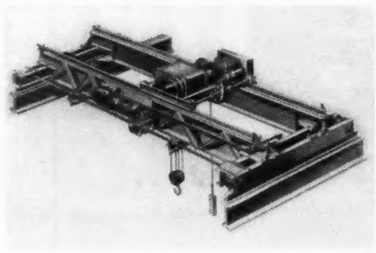
long and weighs only 3 3/4 pounds. The universal motor has a "no load" speed of 1800 R.P.M. Also available in six other speeds ranging from 550 to 5000 R.P.M. E-111

Parker Insert-Roll Holder for Marking Dies

Roll type holder for marking dies, developed by the Parker Stamp Works, Inc., Hartford, Conn. These new hold-

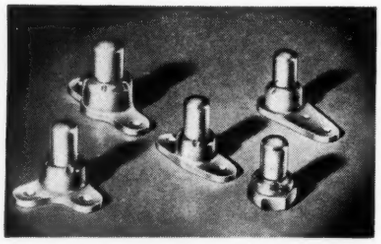


ers, known as the Parker 100 series, are machined and ground from a very tough alloy steel, then hardened throughout and finish-ground on the surfaces which come in contact with the segment inserts when assembled. The inserts are likewise ground on the surfaces which contact the holder, thus insuring tight fits and eliminating any movement or looseness of the inserts themselves. E-112



Whiting Hoist Type Crane

E type crane of new line of hoists now being built in capacities up to 12 tons, with spans from 20 to 60 feet, by the Whiting Corporation, Harvey, Ill. Designed for intermittent duty and usually for operation from the floor by means of pendent push-button control station. Can be supplied with cab control or without motors for hand-power operation. E-113

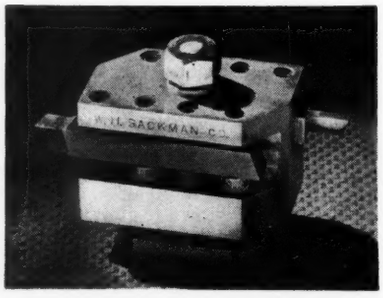


Extra High, Light-Weight, All-Metal Cap Nuts

Extra high, light-weight self-locking all-metal cap nuts introduced by the Elastic Stop Nut Corporation, 2330 Vauxhall Road, Union, N. J. The cap height on the new Type K3 nuts is sufficient to insure full clearance for AN-3 and AN-4 bolts or AN-509 screws. The red elastic collar and the new cap of these nuts form a pressure seal against external or internal liquid and gas pressures of 80 pounds per square inch without leakage. E-114

Tool-Holder for Lathes

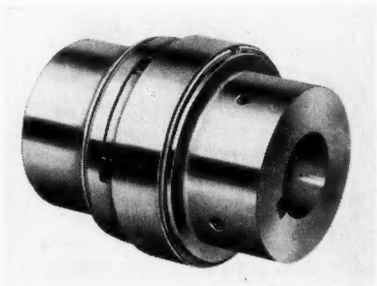
Tool-holder designed to hold rigid, wide tools on comparatively narrow bases without chatter. Two tools can be mounted on the holder. By swinging the holder end for end, all lathe operations, such as threading, forming, cutting off, etc., can be performed. Two



sizes are available for use on 9- to 16-inch lathes. Larger sizes can be made to order. Announced by W. H. Sackman Co., Inc., 44 N. Fourth St., Philadelphia 6, Pa. E-115

Lovejoy L-R Coupling

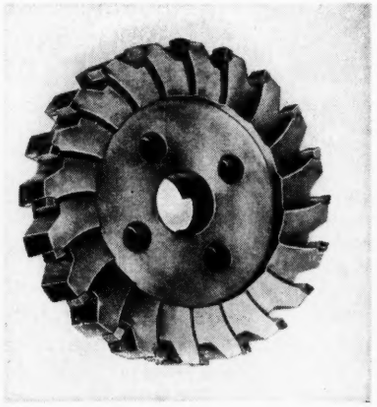
Improved type coupling designed to permit easier installation and make available larger bore capacities. Inside



sleeve is made in two parts instead of one, providing a sleeve in each member of the coupling. Both members are machined alike to fit the removable steel collar, making the two members interchangeable and facilitating assembling of collar on either half of the coupling. Collar is held in place by snap-ring instead of bolts. Made by Lovejoy Flexible Coupling Co., 5021 W. Lake St., Chicago 44, Ill. E-116

Nelco Fine-Tooth Face Mill

New fine-tooth face mill especially designed for milling cast-iron rims and bosses, developed by Nelco Tool Co., Inc., Manchester, Conn. Double the

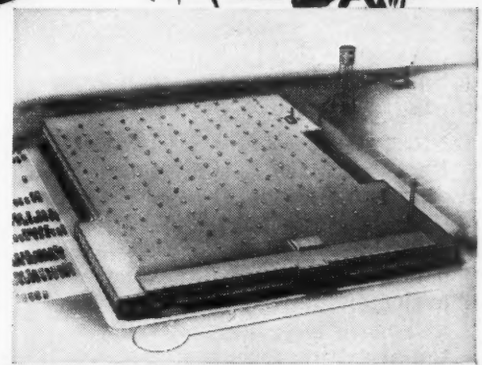


number of teeth normally used in the conventional face mill provides for extra tooth engagement and smoother cutting. This solid "brazed-on" type with alloy-steel body and extra heavy carbide tips (sandwich - brazed with nickel shim) is especially adapted for use where rigidity and long cutter life are prime requisites. Available in 6-, 8-, 12-, and 14-inch diameters...E-117

To obtain additional information on equipment described here, use Inquiry Card on page 225.

"AMERICAN Screw Company?

. . . please call the NEW NUMBER . . . at WILLIMANTIC CONNECTICUT!"



. . . and get fastest fastener-service from this modern, high-production plant

Save time and "wrong numbers" by changing your records *now* to the address of American's new main plant and home office.

This high-production operation . . . one of the most modern in the screw industry . . . is equipped and staffed to raise American quality and service to new high levels, both in American Phillips Recessed-Head Fasteners, and also slotted products. Whatever it takes to make better screws, American has it at Willimantic!

Photos at the right give you a good picture of American's present position on deliveries. So for either Phillips or slotted, mark your order *American* . . . and shoot it to Willimantic.

AMERICAN SCREW COMPANY

Plants at Willimantic, Conn., and Norristown, Pa.

Warehouses at:

589 E. Illinois St. Chicago 11 — **502 Stephenson Bldg. Detroit 2**

Wire Storage

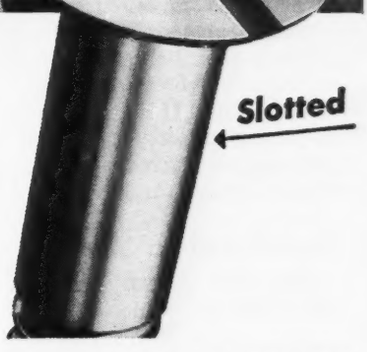
Cut Threading Dept.

Shipping Dept.

4-WINGED DRIVER CAN'T SLIP OUT OF PHILLIPS TAPERED RECESS

Phillips

AMERICAN SCREWS



Slotted

New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To obtain copies of these publications, fill in identifying number at end of descriptive paragraph on Inquiry Card, page 225, or write directly to manufacturer, mentioning catalogue described in the June, 1950, number of MACHINERY.

Small Tools

PRATT & WHITNEY DIVISION NILES-BEMENT-POND CO., West Hartford 1, Conn. Catalogue 17, containing 462 pages of information on P & W precision cutting tools, including sizes, prices, and data designed to facilitate the selection and ordering of taps, dies, milling cutters, punches, carbide-tipped cutting tools, etc. One section of the book contains 100 pages of tables and reference material. Copies can be obtained if requested on a business letterhead directed to the company.

Micrometer Dial Gages and Indicators

B. C. AMES CO., Waltham, Mass. General catalogue 58, covering the company's complete line of micrometer dial gages and indicators. Copies will be sent to those who request them on a company letter-head directed to the B. C. Ames Co.

Copper and Copper Alloy Specifications

AMERICAN BRASS CO., Waterbury 20, Conn. Publication B-34, entitled "Copper and Copper Alloy Specifications Index." Section I lists the most generally used alloys of the company, together with the applicable specifications of the various national engineering societies and government agencies; while Section II lists specifications in numerical order, with a brief description of grade, type, temper, anneal, etc. C-1

Heat-Treating

REPUBLIC STEEL CORPORATION, Cleveland 27, Ohio. Booklet entitled "Heat-Treating Republic Alloy Steels," explaining various heat-treating methods and including charts showing the mechanical properties obtainable at different temperatures in tempering twenty-one types of alloy steels, as well as charts giving critical points, depths of carburized case, and depths of nitrided case..... C-2

High-Production Machines

CINCINNATI MILLING AND GRINDING MACHINES, INC., Cincinnati 9, Ohio. Circular M-1705, entitled "Engineering for Production," containing reprint of a lecture delivered before a meeting of the A.S.M.E. by Carl Beach, assistant sales manager of the company. Examples of machines and equipment designed to meet specific needs are described and illustrated. C-3

Rust Prevention

OAKITE PRODUCTS, INC., 126 Thames St., New York 6, N. Y. Service report describing specialized materials and procedures for removing rust from raw stock; cleaning and derusting in one operation; preventing rust while parts are being processed; and preparing metal for paint, with protection against rust. C-4

Oxy-Acetylene Flame-Hardening

AIR REDUCTION SALES CO., 60 E. 42nd St., New York 17, N. Y. Circular ADR-63, entitled "Oxy-Acetylene Flame-Hardening in Commercial Heat-Treatment," covering materials that can be treated by this process, various flame-hardening methods, and typical applications. C-5

Pneumatic and Hydropneumatic Die Cushions

CLEARING MACHINE CORPORATION, 6499 W. 65th St., Chicago 38, Ill. Bulletin 212, illustrating and describing the Clearing line of pneumatic and hydropneumatic die cushions for all makes of power presses, including information on operation and data for use in planning installations. C-6

Heat-Resistant Stainless Steel

ARMCO STEEL CORPORATION, Middletown, Ohio. Booklet entitled "Stainless Steel for Heat Resistance," containing basic information for material and design engineers on high-temperature metal applications and data on how to select the most economical stainless steel for any use..... C-7

Precision Grinder-Millers

PRECISE PRODUCTS CO., 1328-30 Clark St., Racine, Wis. Catalogue FG-8, describing the company's new "Super 50" grinder-miller and a complete new line of precision mounts which make it possible to use the equipment for precision grinding, milling, etc., on standard machine tools. C-8

Hydraulic Presses for Sheet-Metal Working

BIRDSBORO STEEL FOUNDRY & MACHINE CO., Birdsboro, Pa. Bulletin C-1A, describing the mechanical features and application of Birdsboro hydraulic presses for sheet-metal working. Data of aid in selecting the right press for various purposes is also given..... C-9

Multipresses

DENISON ENGINEERING CO., 1152 Dublin Road, Columbus 16, Ohio.

To obtain copies of these publications, fill in number at end of note on Inquiry Card, page 225.

Catalogue entitled "Denison Multipress and How You Can Use It," descriptive of the construction of machine, together with its controls and attachments, and its application on a wide variety of work. C-10

Power Tools

WALKER - TURNER DIVISION, KEARNEY & TRECKER CORPORATION, Plainfield, N. J. Catalogue A, containing 32 pages of technical information and specifications on Walker-Turner power tools for metal- and wood-working, including drill presses, saws, flexible-shaft machines, jointers, etc. C-11

Air and Hydraulic Equipment

HANNIFIN CORPORATION, 1110 S. Kilbourn Ave., Chicago 24, Ill. Pocket size folder descriptive of the company's line of air control valves and air- and hydraulic-operated presses, hydraulic and pneumatic cylinders, and allied equipment recently exhibited at the A.S.T.E. exposition. C-12

Pressed-Metal Products

WESTERN PRESSED METALS DIVISION OF DOUGLAS AIRCRAFT CO., INC., Santa Monica, Calif. Booklet describing the complete facilities and services offered by the company for producing steel stampings, including the use of Kirksite dies for producing runs of 50,000 or more. C-13

Lubricants

ACHESON COLLOIDS CORPORATION, Port Huron, Mich. Bulletin 424, describing colloidal-graphite lubricants, made in different forms for use in internal combustion engines and industrial machinery, as well as for high-temperature lubrication, and fast drying applications. C-14

Shop Tools

J & S TOOL CO., INC., 470 Main St., East Orange, N. J. Booklet entitled "Machine Shop Time-Savers," descriptive of "Fluid-motion" radii and angle dressers for cylindrical grinding machines; "circular" cutting tools; vise jaws; parallels; etc. C-15

Numbering Equipment

WILLIAM A. FORCE & CO., INC., 216 Nichols Ave., Brooklyn 8, N. Y. Pocket-size catalogue J, on rotary numbering heads and typographical numbering machines, brought out in connection with the seventy-fifth anniversary celebration of the company. C-16

Carbide Tools

SUPER TOOL CO., 21650 Hoover Road, Detroit 13, Mich. Catalogue 50, containing 64 pages covering the entire line of standard carbide tools manufactured by the company. Recommended applications, feeds and speeds, and grinding instructions are included. C-17

"Whirlpool" Cleaning Equipment

J. P. MFG. CO., 330 E. Front St., Youngstown 3, Ohio. Catalogue illustrating and describing various types of "whirlpool action" cleaning equipment for degreasing, washing, and cleaning metal parts and machines. C-18

Vibration Control

KORFUND CO., INC., 48-39-M Thirty-Second Place, Long Island City 1, N. Y. Bulletin G-102, containing data on vibration-control materials, together with a selector chart recommending the right type of vibro-isolators for various applications. C-19

Flexible Tubing

FLEXIBLE TUBING CORPORATION, Branford, Conn. Catalogue describing "Spiratube," a new lightweight flexible tubing for ventilation, products conveying, and other industrial uses where high wear and heat resistance are required. C-20

Small Motors

BARBER - COLMAN CO., 9217 Loomis St., Rockford, Ill. Catalogue describing and illustrating Barcol small unidirectional, reversible, and synchronous power motors. Wiring diagrams and performance data are included. C-21

Assembling and Finishing Carbide Header Dies

CARBOLOY COMPANY, INC., 11147 E. Eight Mile Ave., Detroit 32, Mich. Bulletin D-127, giving detailed instructions for assembling and finishing carbide dies used in heading bolts, screws, etc. C-22

Visual Planning Equipment

VISUAL PLANNING EQUIPMENT CO., INC., Oakmont, Allegheny Co., Pa. Catalogue describing the importance of visual, or three-dimensional, planning equipment for plant lay-out, its application, and cost. C-23

Traveling-Wheel Grinders

MATTISON MACHINE WORKS, Rockford, Ill. Bulletin 844-2RM, descriptive of the Mattison "Hanchett type" traveling-wheel grinder especially suitable for grinding surfaces of parts that are heavy, long, and awkward to handle. C-24

Reinforced-Hub Abrasive Wheel

NORTON CO., Worcester 6, Mass. Bulletin descriptive of the new Norton reinforced-hub abrasive wheel by means of which it is possible to rough- and finish-grind with the same wheel. C-25

Steel Shop Equipment

STANDARD PRESSED STEEL CO., Jenkintown 19, Pa. Bulletin 718, on the new Hallowell "700" steel platform trucks. Bulletin 721, announcing the company's new and improved line of steel foremen's desks. C-26

Precision Lapping Machines

CRANE PACKING CO., LAPMASTER DIVISION, Dept. G-29, 1800 Cuyler Ave., Chicago 13, Ill. Booklet illustrating and describing the "Lapmaster" for automatic high-production lapping to extremely close tolerances. C-27

Ornamental Grilles

HARRINGTON & KING PERFORATING CO., 5655 Fillmore St., Chicago 44, Ill. Catalogue containing 48 pages showing various designs of ornamental grilles, including fixed and movable louvers, special panels, and enclosures. C-28

Punch-Press Safety Devices

F. J. LITTELL MACHINE CO., 4127 Ravenswood Ave., Chicago 13, Ill. Circulars descriptive of Littell punch-press safety devices, including feeders, mechanical pickers, and air-blast valves for ejecting stamped parts. C-29

Drill and Tap Chucks

SCULLY-JONES & CO., 1906 S. Rockwell St., Chicago 8, Ill. Bulletin 1-50, covering the company's line of drill and tap chucks, including complete specifications and prices. C-30

To obtain copies of these publications, fill in number at end of note on Inquiry Card, page 225.

Electrolized Cutting Tools

CUTTING TOOLS, INC., 13503 St. Claire Ave., Cleveland 10, Ohio. Circulars descriptive of the electrolizing process for increasing the life of tools and parts, together with data on the savings possible with this process. C-31

Abrasive Cutting Machine

ANDREW C. CAMPBELL DIVISION, AMERICAN CHAIN & CABLE CO., INC., Bridgeport, Conn. Circular descriptive of the outstanding features of the new Campbell low-cost wet abrasive cutting machine of the bar stock type....C-32

Hacksaw and Band-Saw Blades

HENRY G. THOMPSON & SON CO., New Haven, Conn. Folders featuring Milford flexible "Rezistor" and "All Hard" hacksaw blades, and Milford profile and "Wavy Set" band-saw blades. C-33

Cutting Tools

SEVERANCE TOOL INDUSTRIES, INC., Saginaw, Mich. Catalogue 18, listing the company's line of midget mills, deburring cutters, countersinks, reamers, etc., and giving pertinent technical information. C-34

Abrasive Cut-Off Machines

TABOR MFG. CO., 6225 Tacony St., Philadelphia 35, Pa. Bulletin illustrating and describing four new 3-H.P. abrasive cut-off machines for bevel wet and dry cutting and for right-angle wet cutting. C-35

Mechanical and Hydraulic Jacks

TEMPLETON, KENLY & CO., 1020 S. Central Ave., Chicago 44, Ill. Catalogue 50, containing 32 pages of specifications and application data on mechanical and hydraulic jacks. C-36

Air-Line Purifying and Lubricating System

AIRLUBE, INC., 3422 W. North Ave., Chicago 4, Ill. Folder descriptive of Airlube dual control system for purifying and lubricating low-pressure air lines.....C-37

Extrusion Presses

LAKE ERIE ENGINEERING CORPORATION, 170 Woodward Ave., Buffalo 17, N. Y. Bulletin 14.1, illustrating and describing the latest equipment for extruding various types of materials. C-38

Compressed Air and Gas Power

COMPRESSED AIR AND GAS INSTITUTE, 1410 Terminal Tower, Cleveland 13, Ohio. Booklet containing extensive basic reference data on compressed air and gas power and its application.....C-39

Vertical Production Lathes

REED - PRENTICE CORPORATION, Worcester, Mass. Bulletin illustrating and describing the Reed-Prentice automatic vertical production lathe, including a cycle and set-up diagram. C-40

Gear-Grinding Machine

COSA CORPORATION, 405 Lexington Ave., Chrysler Bldg., New York 17, N. Y. Bulletin ZA50, illustrating and describing the Reishauer ZA tooth-flank high-precision gear-grinder. C-41

Precision Vernier Calipers

SWEDISH GAGE CO. OF AMERICA, 8900 Alpine Ave., Detroit 4, Mich. Leaflet announcing a new precision vernier caliper for both internal, external, and depth measurements. C-42

Tungsten-Carbide Tools

WILLEY'S CARBIDE TOOL CO., 1340 W. Vernor Highway, Detroit 1, Mich. Catalogue containing specifications for the company's line of tungsten-carbide tools. C-43

Miniature Ball Bearings

LANDIS & GYR, INC., 104 Fifth Ave., New York 11, N. Y. Bulletin showing how small pivot bearings and tiny radial ball bearings should be mounted. C-44

Reversible Ratchet Wrenches

LOWELL WRENCH CO., Worcester 8, Mass. Catalogue 60, illustrating and describing a reversible ratchet wrench having several new features. C-45

Research Microscopes

BAUSCH & LOMB OPTICAL CO., Rochester 2, N. Y. Catalogue D-1010, descriptive of a new series of research microscopes recently added to the company's line...C-46

Carbide Gage-Blocks

FONDA GAGE CO., INC., Stamford, Conn. Circular listing reduced prices on the company's line of "Lifetime" carbide gage-blocks. C-47

Centrifugal Pumps

INGERSOLL-RAND CO., 11 Broadway, New York 4, N. Y. Folder descriptive of the company's new line of cradle-mounted centrifugal pumps. C-48

Coolant Pumps

W. A. HOREJSI CO., 2001 James Ave., N., Minneapolis, Minn. Leaflet descriptive of the "Lubri-King" foot-powered coolant pump unit. C-49

Mounted Abrasive Wheels and Points

BAY STATE ABRASIVE PRODUCTS CO., Westboro, Mass. Circular describing the features of Bay State mounted wheels and points.... C-50

Air Tools

BUCKEYE TOOLS CORPORATION, 21 W. Apple St., Dayton 1, Ohio. Catalogue containing 44 pages of data on the Buckeye line of portable air tools. C-51

Electrodes

ELECTRIC WELDING ALLOYS CORPORATION, 40 Worth St., New York 13, N. Y. Circular announcing a new electrode for welding cast iron. C-52

Electric Drills and Attachments

ROTO-POWER CORPORATION, 283 Greene Ave., Brooklyn 5, N. Y. Circular on the company's electric tools and attachments. C-53

Drafting Machines

V & E MFG. CO., Pasadena 20, Calif. 34-page booklet entitled "How to Use 'Vemco' Drafting Machines." C-54

Cold-Heading

CONTINENTAL SCREW CO., New Bedford, Mass. Folder entitled "Cold-Heading Hints for Reducing Fastener Costs." C-55

Turret Milling Machines

BRIDGEPORT MACHINES, INC., Bridgeport, Conn. Folder illustrating the Bridgeport turret milling machine. C-56

To obtain copies of these publications, fill in number at end of note on Inquiry Card, page 225.

By E. S. Salichs

BETWEEN GRINDS

Not Fickle with His Nickel

When Mr. Samuel Howells of Detroit recently renewed his subscription, he amplified somewhat: "I started to work for the Bickford Tool Co., now the Cincinnati Bickford Tool Co., on December 28, 1898, at 5 cents per hour. As soon as I could save $1, I subscribed to MACHINERY and have been reading it ever since."

Don't Blink at Laduby

There is a Laduby Flur-o-lamp Disposal now on the market—a machine that grinds up your old light bulbs. Machine does its crunching under water at the rate of 100 lamps in about 10 minutes. What an appetite for ground glass!

Ferries in the Air

A helicopter ferry, the first scheduled service of its kind, will operate between Cardiff and Liverpool, starting in June. British European Airways will carry Britons in four-seater Sikorsky S-51s. No room for shoe shine boys and accordion players would seem.

Though Trite, Quite Right!

Glancing through a pocket dictionary of machine shop terms, we happened upon this definition: "Terrible—a one-word description of poor workmanship."

And the Food is Served Piping Hot

A hotel in the steel town of Gary, Ind., features two breakfast specials—one called "Blast Furnace" and the other "Open Hearth."

Beer Barrel Soundings

Production of a new, heavier gage aluminum beer barrel of 31-gallon capacity featuring a deeper chime and resulting in more rugged construction to withstand rough handling, has been announced by the Aluminum Company of America. Chime is the edge or rim of a cask, not the barrel ringing happily as it rolls along to its destination.

Shockproof Steel?

At an annual stockholders' meeting of the U. S. Steel Corporation, Chairman Irving S. Olds called the lively meeting to order by bringing down the gavel on his watch.

1950 No-Prize-But-Glory Quiz

One cubic foot of brass weighs 550 pounds. What for iron? What for aluminum? What for magnesium? According to a Hills-McCanna match cover, the answer is: iron, 450 pounds; aluminum, 178 pounds; magnesium, 113 pounds.

Author's Antidote

Received a contribution in the mail, and with it a notation: "If the result is distressing, send the article back to me."

FORMULAS ARE FUN—William Walter Johnson was born in Cleveland, Ohio, and after a college business course served a three-year machinist apprenticeship with the F. H. Bultman Co. At the turn of the century, he was building optical instruments for the Warner & Swasey Co., then spent thirteen years with the American Multigraph Co. Twelve years as chief engineer of the Trundle Engineering Co. and tool engineer from 1933 to 1949 with the National Acme Co. rounded out Mr. Johnson's mechanical career of designing and building tools and dies for interchangeable manufacture, fine instruments, light and medium machinery. But that's not all—correlated with all this were years devoted to his hobby of mathematics, which has included teaching applied mathematics and mechanics since 1932 at the John Huntington Polytechnic Institute in Cleveland, and writing numerous articles on math for the technical press (Mr. Johnson reminded us that he had contributed heavily to our book "Draftsman's Mathematical Manual," which was first published in 1924, and the preface to which we then referred bears him out). Mr. Johnson is a charter member of the American Mathematical Association of America. Perhaps his philosophy has keynoted his progress: "Unless you attempt something beyond what you already have done, you will never grow." (And now turn to page 184 for a sample of Mr. Johnson's work—or play—juggling squares, hexagons and octagons.)

Photo, Madison Geddes

News of the Industry

Canada

HERBERT H. ROGGE was recently elected president and chief executive officer of the Canadian Westinghouse Co., Ltd., Hamilton, Ontario. At the same time, the board of directors elected HAROLD A. COOCH, former president, to the position of chairman of the board, succeeding JOHN R. READ, who is retiring after fifty years of service. Mr. Rogge has been connected with Westinghouse since 1922, having formerly been located in New York.

California, Washington, and Arizona

CARL E. JOHNSON, for many years president of Sterling Electric Motors, Inc., Los Angeles, Calif., was recently elected chairman of the board, and is succeeded in the presidency by EARL MENDENHALL, who has been associated with Mr. Johnson for over thirty-four years.

WALTER H. BRAMMAN has joined the sales force of the Black & Decker Mfg. Co., Towson, Md., manufacturer of portable electric tools. He will be located at Spokane, Wash.

GEORGE S. THOMSON CO., 915 S. Central Ave., Phoenix, Ariz., has been appointed representative for the CHIKSAN CO., Brea, Calif.

Connecticut and Massachusetts

AMERICAN SCREW CO., manufacturer of American Philips screws and slotted fasteners, recently completed moving all the administrative, engineering, production, purchasing, sales and research departments of the company from Providence, R. I., where the company has been located for over one hundred years, into a new modern one-story plant at Willimantic, Conn. The removal of the plant was done gradually, having been started about three years ago so as to cause the least disruption possible in service. The latest types of equipment have been installed in the various departments and the plant is laid out for straight-line production to insure maximum speed of output. The new site covers 87 acres, and the plant consists of four brick and concrete buildings. The facilities of the new plant include engineering research laboratories provided with the most modern types of testing equipment.

PRATT & WHITNEY DIVISION NILES-BEMENT-POND CO., West Hartford, Conn., recently honored two of its employes whose combined years of service totaled seventy years. The men are HUBERT D. TANNER, vice-president and director, who has been with the company for thirty years, and FRANK O. HOAGLAND, master mechanic, who has been a Pratt & Whitney employe for forty years. Both are recognized authorities in the machine tool field. FREDERICK U. CONARD, president and general manager of the Niles-Bement-Pond Co., presented each man with a gold service pin during separate ceremonies.

Forty-year service pin is bestowed upon Frank O. Hoagland, Pratt & Whitney master mechanic, by Frederick U. Conard, president and general manager of Niles-Bement-Pond Co.

Frank W. Curtis, chief engineer of Machine Tool Division for the Van Norman Co.

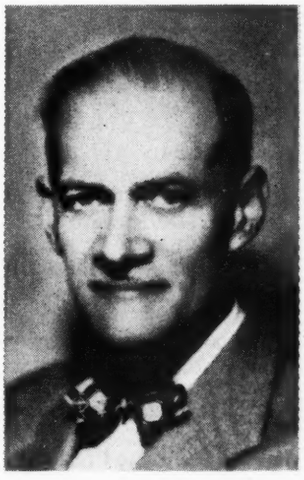
FRANK W. CURTIS has been appointed chief engineer of the entire Machine Tool Division of the Van Norman Co., Springfield, Mass. This division includes milling machines, oscillating grinders, and the Van Norman-Fitchburg line of production grinding machines. For the last six years Mr. Curtis has been a consulting specialist on high-frequency induction and dielectric heating. Prior to that he had been associated with the Van Norman Co. in a capacity similar to his present one.

WHITON MACHINE CO., New London, Conn., manufacturer of lathe chucks, centering machines, and gear-cutting machines, announces the appointment of the following dealers: AMERICAN STEEL & SUPPLY CO., Chicago 4, Ill.; HIBBARD, SPENCER, BARTLETT CO., Evanston, Ill.; KEISER-VAN LEER CO., Bloomington, Ill.; CLARKE F. SANFORD & CO. and SOUTH BEND SUPPLY CO., St. Louis, Mo.; INDUSTRIAL EQUIPMENT & SUPPLY CO., Benton Harbor, Mich.; MILES MACHINERY CO., Saginaw, Mich.; HOWARD & SMITH, INC., and MCKEE-KENYON & CO., Detroit, Mich.; NEILL-LAVIELLE SUPPLY CO., Louisville, Ky.; and STEEL CITY TOOL & SUPPLY CO., Pittsburgh, Pa.

ALBERT P. HAYDEN has been made superintendent of wire rope and tramway engineering for the American Steel & Wire Co., New Haven, Conn., and JOHN A. HERR has been advanced to the position of assistant superintendent of that department. Mr. Hayden succeeds GORDON H. BANNERMAN who recently became manager of the newly created Tramway Division of the Columbia Steel Co., western subsidiary of the United States Steel Corporation.

GEORGE DEMOUGEOT has been appointed plant manager of Sperry Products, Inc., Danbury, Conn.

OLIVER W. BONNAFE was recently elected vice-president in charge of research engineering by the Lapointe Machine Tool Co., Hudson, Mass. He



Oliver W. Bonnafe, vice-president in charge of research engineering for the Lapointe Machine Tool Co.

has been associated with the company for over thirty years, and is well known for his contributions to the advancement of broaching.

THOMAS SPROULE, production manager of the Fitchburg, Mass., Works of the General Electric Co.'s Welding Division has been appointed assistant manager of manufacturing for the Fitchburg Turbine and Welding Divisions.

Illinois and Indiana

REED-PRENTICE CORPORATION, Worcester, Mass., announces the opening of a new sales office at 2400 W. Madison St., Chicago 12, Ill., with J. H. WOLCOTT as manager. Mr. Wolcott was manager of the Los Angeles office of the company for three years, and will be succeeded in that position by IVER J. FREEMAN. CHARLES HOLLAND has been named sales engineer at the Chicago office.

FRANK W. BEMM, vice-president in charge of manufacturing of the Advance Spring Corporation, Chicago, Ill., has been elected president, succeeding D. E. MIELKE, who is no longer connected with the company. WILLIAM J. GREDE, president of Grede Foundries, Inc., Milwaukee, Wis., will serve as vice-president and director.

ROY C. INGERSOLL, previously vice-president of the Borg-Warner Corporation, Chicago, Ill., was elected president at a recent meeting of the board of directors to succeed C. S. DAVIS who has held the position for the last twenty-one years. Mr. Davis was elected to the newly created office of chairman of the board.

EARL M. NELSON has been appointed regional sales manager for fifteen midwestern states by the National Electric Products Corporation, Pittsburgh, Pa. His headquarters are at 2300 W. Division St., Chicago, Ill.

ROBERT W. RICE & CO., INC., machinery dealers, announce the removal of their offices and salesroom to new quarters at 210 S. Clinton St., Chicago 6, Ill.

LOVE MACHINE & TOOL CO., Indianapolis, Ind., manufacturer of dies, jigs, and fixtures, has purchased the physical assets and inventory of the MERZ ENGINEERING CO., 200 S. Harding St., Indianapolis 7, Ind., maker of standard and special gages, precision aircraft products, special machinery, etc. The facilities of the two companies will be incorporated in the plant of the Merz Engineering Co., and the business will be continued under the name of MERZ ENGINEERING, INC. The new organization will manufacture dies, jigs, and fixtures, as well as a complete line of standard and automatic gages. The president of the company is MIKLOS SPERLING; chief engineer, CHESTER D. SCHUMAN; and works manager, TROY A. WILEY.

Michigan and Wisconsin

E. W. CONNOLLY has been appointed sales manager of the Detroit district of the Haynes Stellite Division of Union Carbide and Carbon Corporation, 30 E. 42nd St., New York 17, N. Y. Mr. Connolly has been associated with the Haynes Stellite Division for eleven years as sales engineer at Detroit. He succeeds R. D. GUNTHER, who has retired.

SNYDER TOOL & ENGINEERING CO., Detroit, Mich., announces that an arrangement has been made by which the ARTHUR COLTON DIVISION of the company will build and market powdered metal presses incorporating the patents, designs, and process techniques developed by the MICHIGAN POWDERED METAL PRODUCTS CO., Northville, Mich.

MOTOR TOOL MFG. CO., manufacturer of live centers, has moved to its new factory in northeast Detroit. The address of the company is now P. O. Box 3805, Park Grove Station, Detroit 5, Mich.

ROBERT C. BLACKINTON has been appointed plant manager of the Pioneer Engineering & Mfg. Co., Detroit 3, Mich.

J. M. FLOYD, who has been vice-president in charge of manufacturing for the A. O. Smith Corporation, Milwaukee, Wis., has been named executive vice-president.

Missouri

THOMAS M. STINSON, formerly district sales manager of the United States Steel Products Co., in the St. Louis, Mo., territory, has been appointed general manager of sales, with headquarters at 30 Rockefeller Plaza, New York City. He is succeeded at St. Louis by G. P. WARDLEY, JR., formerly a salesman at the Bennett Mfg. Division of the company in Chicago.

DICE COWGER has been appointed St. Louis district manager of the diesel engine department of the Nordberg Mfg. Co., Milwaukee, Wis. His headquarters are at the Busch-Sulzer Brothers Diesel Engine Co. Division of the company in St. Louis, Mo.

EDWIN S. PILLSBURY, one of the founders of the Century Electric Co., St. Louis, Mo., and president since 1914, has relinquished the presidency to be succeeded by his son, FRED H. PILLSBURY.

New York and New Jersey

HENRY W. BECK has been appointed advertising manager of Airco Co. International, with headquarters at 33 W. 42nd St., New York 18, N. Y. He was previously assistant manager, advertising department, for Air Reduction Sales Co. His former duties will be divided between WILLIAM C. BETTES, who will be responsible for trade paper advertising, and GEORGE M. WORDEN, who will have charge of publicity.

WINSMITH-BUFFALO, Marine Trust Bldg., Buffalo 3, N. Y., has been appointed representative of the WINFIELD H. SMITH CORPORATION, Springville, N. Y., manufacturer of speed

reducers. Winsmith-Buffalo is a new company under the management and ownership of L. D. AYDELOTTE, formerly sales manager of the Winfield H. Smith Corporation.

C. C. CLYMER has been appointed manager of the Materials Handling and Testing Equipment Division of the Industrial Engineering Division of the General Electric Co., Schenectady, N. Y., replacing M. A. DEFERRANTI, who has been made assistant to A. W. JACOBSEN, manager of the Parts Division, Aircraft Gas Turbine Divisions.

D. F. CISNEY has been named advertising manager of A. Schrader's Son, Brooklyn, N. Y., manufacturer of pneumatic valves, to replace D. S. HUNTER. The concern also announces the appointment of WALLACE C. MANVILLE as resale representative in the Denver territory.

HAUSER MACHINE TOOL CORPORATION, 30 Park Ave., Manhasset, N. Y., has been appointed exclusive United States representative for SAFAG, S. A., Bienne, Switzerland, manufacturer of precision gear-cutting, milling, and grinding machines.

EMMET F. HARDING, formerly general sales manager of the American Hardware Corporation's Corbin Screw Division, New Britain, Conn., has joined the Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y., as manager of screw sales.

POTTER INSTRUMENT CO., INC., manufacturer of electronic counters and allied equipment, announces the removal of its plant from Flushing, N. Y., to a new factory at 115 Cutter Mill Road, Great Neck, L. I.

EDMOND J. HAGAN has been appointed sales representative for the press and power tool department of the Baldwin Locomotive Works, Philadelphia, Pa. His headquarters will be at the New York district sales office.

PAUL M. DEAL has been made administrative assistant in the Fractional-Horsepower Motor Divisions of the General Electric Co., Schenectady, N. Y.

METAL & THERMIT CORPORATION announces the removal of its New York offices from 120 Broadway, where they have been located for the last thirty-five years, to 100 E. 42nd St., New York 17, N. Y.

D & G ENGINEERING CO., 568 W. Hoffman Ave., Lindenhurst, L. I., announces the purchase of the complete Screw Machine Division of the City Engineering Co., Dayton, Ohio.

SYLVANIA ELECTRIC PRODUCTS, INC., has moved to new headquarters at 1740 Broadway, New York 19, N. Y., bringing together all divisions and departments in the New York area.

AGALOY TUBING CO., Springfield, Ohio, has announced the removal of its New York office to the Chanin Bldg., 122 E. 42nd St., New York 17.

BENNETT MACHINERY CO. announces that it has recently opened a new plant at 375 Allwood Road, Clifton, N. J., for rebuilding, storage, and shipment of machine tools.

Ohio

ROLAND J. AHERN, president and general manager of the Billings & Spencer Co., Hartford, Conn., manufacturer of drop-forgings, wrenches, and shop tools, has been elected a member of the board of the Bingham-Herbrand Corporation, Toledo, Ohio. The latter company acquired control of the Billings & Spencer Co. last year, at which time Mr. Ahern was re-elected president and general manager.

AUTOMATIC STEEL PRODUCTS, INC., Canton, Ohio, has taken over the active management of the CLEVELAND TAPPING MACHINE CO., Hartville, Ohio, and will continue operation of the business under that name. A. R. WISE has been appointed a vice-president of the Cleveland Tapping Machine Co. and will be in charge of sales.

NORM J. KIRK and ROBERT POTTER have been elected vice-presidents of the E. W. Bliss Co., Toledo, Ohio. Mr. Kirk is manager of the Toledo Division, where heavy forming presses are made, and Mr. Potter is manager of the Rolling Mill Division at Salem, Ohio.

E. W. DONKEL has been elected president of the Kent-Owens Machine Co., Toledo, Ohio, manufacturer of special-purpose machinery, to fill the post left vacant by the death of his father on March 3. Mr. Donkel has served as vice-president and general manager for the last six years.

A. F. BOUCHER has been made district manager in the Detroit area for the Lincoln Electric Co., Cleveland, Ohio. He was previously district manager at Milwaukee. I. R. BARTTER has been transferred from Grand Rapids to Milwaukee to take Mr. Boucher's place as district manager in that area.

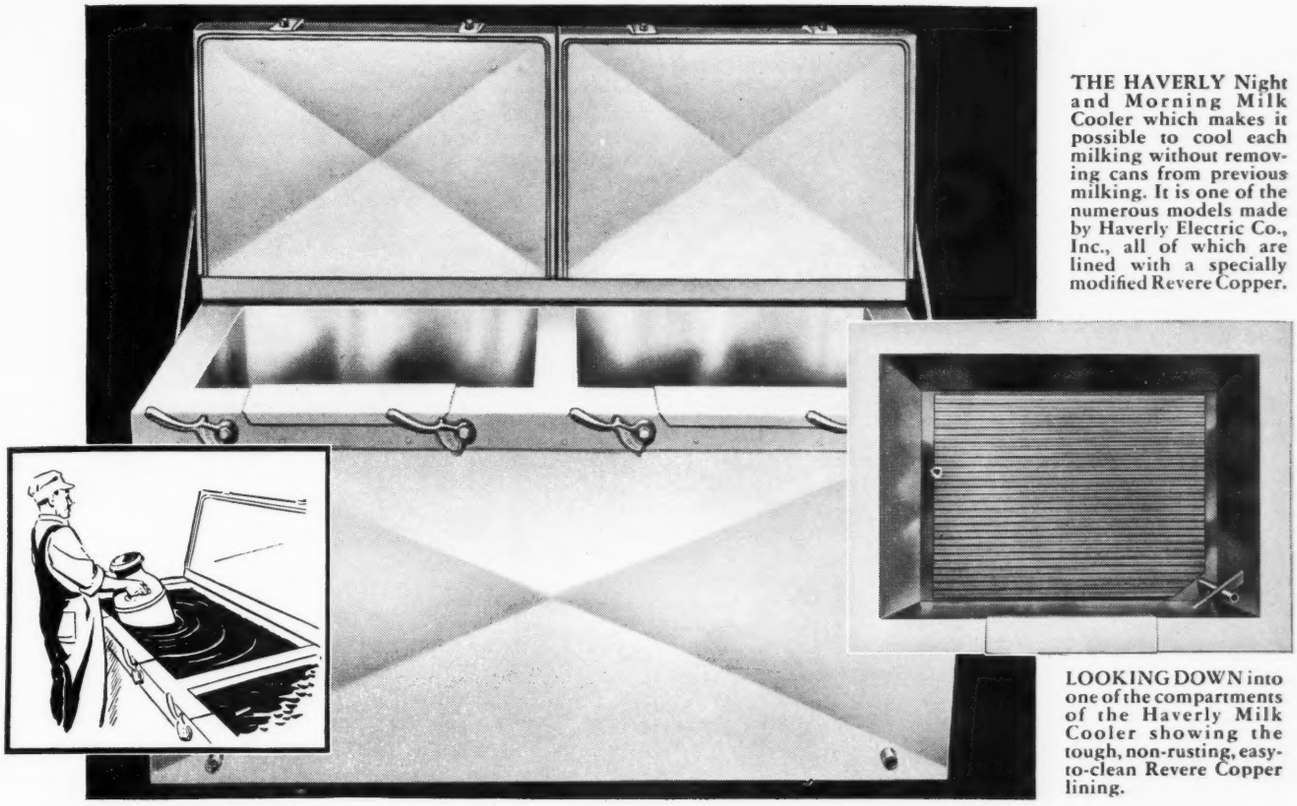
LOUIS POLK, president of the Sheffield Corporation, Dayton, Ohio, has been appointed general chairman of the Technical Divisions and Committees of the American Ordnance Association. Mr. Polk will also continue as chairman of the Gage Industry Division of the Association.

H. O. HOLLAND has been elected vice-president in charge of sales of all divisions of Automatic Steel Products, Inc., Canton, Ohio. He has been director of sales since 1947. JOHN E. CARNAHAN has been named vice-president of the Spun Steel Division of the corporation.

A. B. PARNALL has been elected vice-president, manufacturing, and ROBERT WIER, JR., vice-president, Brush Division sales, of the Osborn Mfg. Co., Cleveland, Ohio, maker of industrial brushes and foundry molding machines.

HEPPENSTALL CO., Pittsburgh, Pa., manufacturer of steel forgings, announces the removal of its Cleveland sales office from 311 Rockefeller Bldg. to 506 Terminal Tower Bldg.

(Left) Norm J. Kirk and (Right) Robert Potter, newly elected vice-presidents of the E. W. Bliss Co.



THE HAVERLY Night and Morning Milk Cooler which makes it possible to cool each milking without removing cans from previous milking. It is one of the numerous models made by Haverly Electric Co., Inc., all of which are lined with a specially modified Revere Copper.

LOOKING DOWN into one of the compartments of the Haverly Milk Cooler showing the tough, non-rusting, easy-to-clean Revere Copper lining.

HOW COPPER, THE RIGHT COPPER

Increased Sales

OF HAVERLY MILK COOLERS

On farms throughout the country mechanical refrigeration for the cooling of milk has been growing by leaps and bounds. Late in 1945, there were many complaints from the farmers regarding the war-quality rustable material used to line these milk coolers. They were difficult to clean and were rusting out rapidly.

When restrictions were lifted on copper and copper alloys, the Haverly Electric Co., Inc., Syracuse, N. Y., came to Revere to see if non-rusting, easy-to-clean copper could be used. The solution was not as easy as it sounds. For the copper, in addition to its non-rusting and high thermal conductivity properties, also had to be strong enough to withstand the constant banging of 80-lb. cans of milk, and at the same time sufficiently ductile for easy fabrication.

Two Revere sheet metal specialists and their staffs went to work. Tests showed electrolytic copper was not mechanically feasible. Then tests were run with several modified coppers. One of these was found to possess *all* of the requirements.

This use of copper as a liner for milk coolers further resulted in the development of the Haverly "Floating Ice" feature. The ice forms on the side walls of the smooth copper liner; works loose and floats to the surface, adding cracked ice cooling around the top of the can at the cream line, where fast and efficient cooling is needed and proves most profitable. Hence a more efficient unit. Also, due to copper having the highest heat-conductivity of any other commercial metal, copper cooling coils are attached to the outside of the copper lining. This results in greater cooling efficiency and easier cleaning. Here again Revere helped. The Revere welding department developed a fast method of attaching this Revere Dryseal Copper Tube to the lining.

The final outcome is that sales of the Haverly Electric Co., Inc., have increased until they are selling all they can produce of this type cooler, while the mutual knowledge gained has resulted in this company expanding its use of special copper alloys in coolers for other industries.

Perhaps Revere can be of help in developing or improving your product, increasing your sales. Why not call the Revere Sales Office nearest you next time you have a problem in metals?

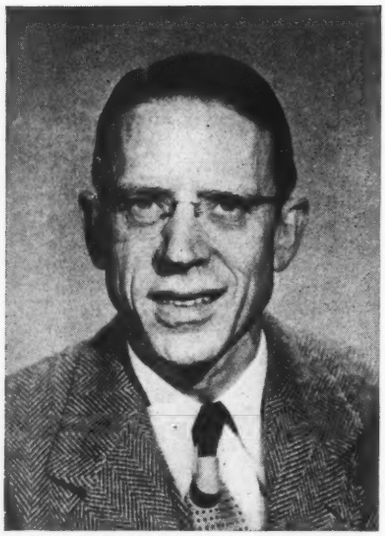
REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.
Sales Offices in Principal Cities, Distributors Everywhere



Stratford B. Biddle, Jr., manager of Seattle sales office of Leeds & Northrup Co.

Pennsylvania and Maryland

LEEDS & NORTHRUP CO., Philadelphia, Pa., manufacturer of electrical measuring instruments, automatic controls, and heat-treating furnaces, has opened a new sales and service office at 603 Stewart St., Seattle 1, Wash., to render prompt service to industry and to scientific and educational institutions in that area. This office will supplement the San Francisco and Los Angeles offices of the company. STRATFORD B. BIDDLE, JR., has been made manager of the Seattle office, and IRA F. OMWAKE, JR., will assist Mr. Biddle.

E. H. FORSSTROM has been appointed to the newly created position of director of training by the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. Mr. Forsstrom was formerly assistant manager of the company's Watervliet, N. Y., plant, and will be succeeded in that position by W. J. BALDWIN, chief metallurgist of the Watervliet plant.

JOHN C. MEVIUS, who for the last ten years has been sales manager of the Materials-Handling Division of the American Engineering Co., Philadelphia, Pa., has been appointed sales manager of the Hydraulic Division. In addition to his new duties, he will continue to be responsible for materials-handling sales.

JOHN S. BARNES CORPORATION, Rockford, Ill., announces the opening of a new Philadelphia sales office. This office will be operated by ERNEST A. ISBERG & Co., Theatre Square, Swarthmore, Pa., and will serve the eastern Pennsylvania, southern New Jersey, and Delaware areas.

CHARLES L. FREEL, formerly manager of the Detroit office of the Lord Mfg. Co., Erie, Pa., has been made administrative assistant to the general sales manager, GEORGE E. TUBB, with headquarters at Erie. EVERETT C. VALLIN replaces Mr. Freel in Detroit.

GLENN R. KRAUS and ERNEST C. HAWKINS have joined the sales force of the Rees Machinery Co., 1012 Empire Bldg., Pittsburgh 22, Pa. Mr. Kraus was formerly associated with the Mesta Machine Co., and Mr. Hawkins with LeMaire Tool & Mfg. Co.

NATIONAL TOOL CO., Cleveland, Ohio, has appointed the TRI-STATE MACHINERY Co., 3041 W. Liberty Ave., Pittsburgh 16, Pa., and 320 E. 31st St., Erie, Pa., sales representative in western Pennsylvania.

MARSHALL E. CUSIC has been made Pittsburgh district sales engineer for the Chain Belt Co., Milwaukee, Wis., and will make his headquarters at 1101 Grant Bldg., Pittsburgh, Pa.

GEORGE H. DEIKE, JR., chief engineer and secretary of the Mine Safety Appliances Co., Pittsburgh, Pa., has been elected a director.

FRANK L. BLODGETT has been appointed sales manager of the Hard Surfacing Division of the Alloy Rods Co., York, Pa.

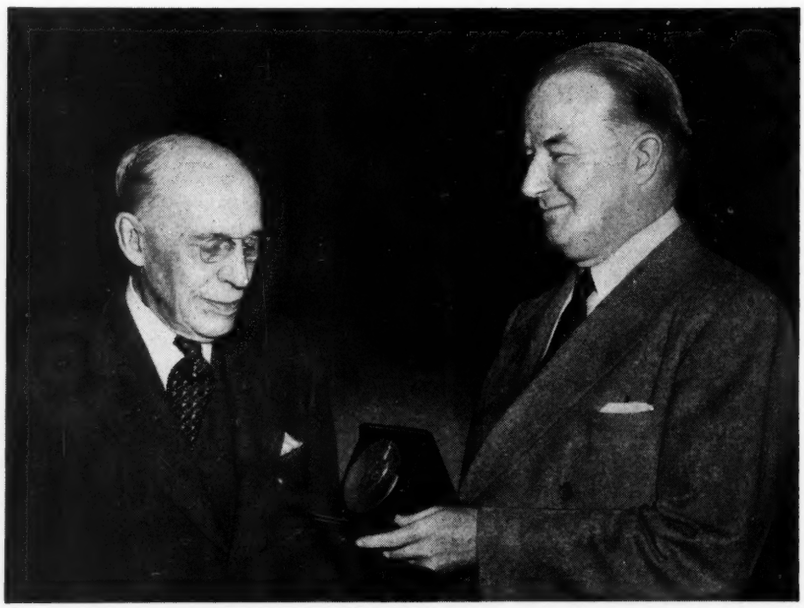
ROBERT T. WOOD has been named chief metallurgist of magnesium products for the Aluminum Co. of America, Pittsburgh, Pa.

EARL V. HARLOW has been appointed engineering assistant to WALTER F. PERKINS, vice-president and general manager of the Metal Products Division of Koppers Co., Inc., Baltimore, Md.

Texas

ROLAND WILKINS, consultant for the American Machine & Foundry Co., has been placed in charge of sales of the high-speed radial saws manufactured by DeWalt, Inc., a subsidiary of the American Machine & Foundry Co., as well as the AMF industrial Lowerator and Wahlstrom chuck, in northern Texas, Oklahoma, and part of Arkansas. Mr. Wilkins' office is at 4615 N. Versailles, Dallas, Tex.

TAFT-PEIRCE MFG. CO., Woonsocket, R. I., has appointed the TOOL SUPPLY & ENGINEERING Co., Dallas, Tex., representative for all Taft-Peirce products except machine tools in Dallas, Fort Worth, and northern Texas.



George Arents (left) one of the founders of the American Machine & Foundry Co., being presented with the AMF Merit Award for fifty years of distinguished service by Morehead Patterson, chairman of the board. The award, the company's highest honor, cited Mr. Arents for "the important part he has played in the growth and continuing progress of the company as director and officer for many years."

For FASTER Production Milling....

The NEW MOTCH & MERRYWEATHER MILLING HEAD

BALANCED SPINDLE, QUILL AND GEAR CONSTRUCTION

ALL GEARS SOLID OR INTEGRAL WITH SHAFTS

MASSIVE STEEL QUILL WITH ADJUSTMENT BY ACME THREAD

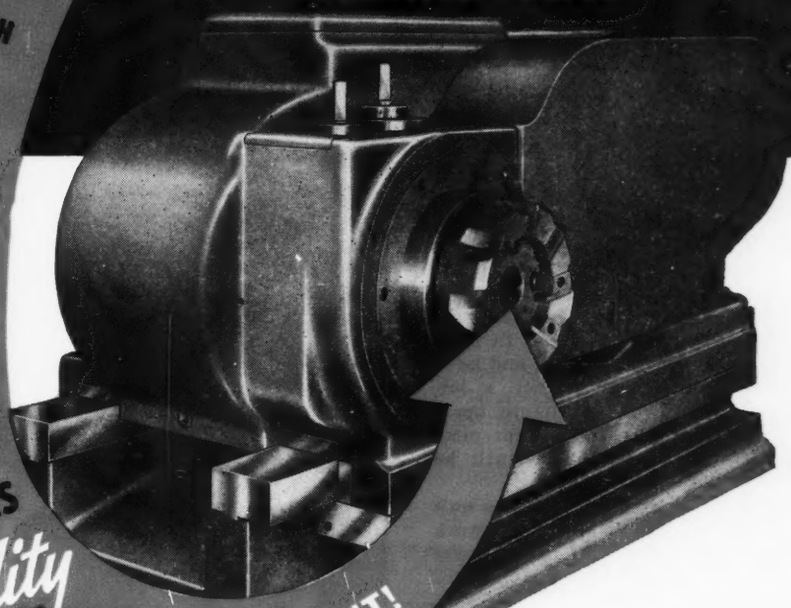
HEAVY DUTY, TAPER ROLLER BEARING SUPPORTS

WIDE FACED, HEAVY DUTY HELICAL GEARING

FLYWHEEL ACTION FROM LARGE SOLID DRIVING GEAR

HARDENED, GROUND STEEL WAYS

THESE FEATURES GIVE *Rigidity* AT THE TOOL POINT!



CAPACITY up to 50 h. p.

Rigidity is needed at the tool point, and the new M. & M. milling head meets this requirement more than amply. Massive, balanced construction prevents vibration, permits heavier cuts and faster feeds, which result in increased production and longer tool life. This new head can be adapted to special production milling machines of our design, which may also combine additional operations into transfer type or trunnion type machines.

Our representative will help you with your problems—no obligation.

Manufactured by

THE MOTCH & MERRYWEATHER MACHINERY COMPANY

715 PENTON BUILDING • CLEVELAND 13, OHIO

Builders of Circular Sawing Equipment, Production Milling, Automatic and Special Machines

PRODUCTION-WITH-ACCURACY MACHINES AND EQUIPMENT

Obituaries

Walter G. Robbins

Walter Guy Robbins, president of the Carboloy Company, Inc., Detroit, Mich., died on May 18 of a heart attack while on a business trip in Schenectady, N. Y., at the age of forty-eight years.

Mr. Robbins was born in Neodesha, Kan., on September 25, 1901. In 1904, his family moved to Seattle and later to Oregon, where his father, a former skilled railroad mechanic, opened a machine shop. He spent most of his youth in the West until he came to Detroit in 1928.

During the first world war he quit school at the age of sixteen to work seven days a week, ten to twelve hours daily, in his father's shop on work for the Government. After the war, he returned to school and worked his way through college, graduating from Oregon State College as a mechanical engineer in 1925.

In 1926, he joined the Stoody Co. in California as a design engineer. When his company bought some cemented tungsten carbide from Krupp A.G., in Germany, Robbins was sent to Detroit to sell it. His success in doing this led to his being hired by the newly formed Carboloy Company, a General Electric subsidiary, as district manager, on January 1, 1929. In 1930, he was made general manager and later vice-president of the company. He was elected president in 1936, a position he had held continuously since that time. Becoming convinced of the approach of war in 1936, he induced the General Electric Co. to expand greatly Carboloy's manufacturing facilities. For his war-time activities he received two personal citations from the U. S. Government.

In addition to his membership on various Industrial Advisory Committees during the war, Mr. Robbins was one of the founders and later president and chairman of the Cutting Tool Manufacturers' Association, an organization of which he was a director at the time of his death. He was also a member of the American Society of Mechanical Engineers and the American Society of Tool Engineers. He was interested in numerous civic activities, and was particularly active in the work of the Cerebral Palsy Association.

Mr. Robbins is survived by his wife, one daughter, and a son.

Ferd. T. Nebel

Ferd. T. Nebel, president of the Nebel Machine Tool Co., Cincinnati, Ohio, died on April 6 of a heart ailment at the age of sixty-eight years. Mr. Nebel was born in Cincinnati on April 1, 1882. He was associated with the company, which was formerly known as the Rahn-Larmon Co., for approximately fifty years. Starting as a draftsman, his unusual ability resulted in his being advanced rapidly to the position of office manager. Upon the death of Mr. Larmon in 1930, he was elected president of the company and was active until the time of his death. Mr. Nebel is survived by his widow and one daughter.

Ferd. T. Nebel

JAMES M. BARTON, formerly chairman of the board of directors and president of the Fretz-Moon Tube Co., Inc., Butler, Pa., died on April 14 at the Butler County Memorial Hospital. Mr. Barton became president of the company in 1929, and was named chairman of the board upon the death of John Moon in 1942, in which capacity he continued until he retired in April, 1948. He had previously retired as president, but continued to serve on the board. Prior to becoming connected with the Fretz-Moon Tube Co., he had been associated with the National Tube Co. for twenty-eight years.

WYNN F. ROSSITER, assistant to the vice-president of the Carpenter Steel Co., Reading, Pa., died on April 24 in Hartford. Conn. Mr. Rossiter was first employed in the Carpenter laboratories at Reading upon his graduation from Reading High School in 1911. Prior to his appointment in 1924 as a salesman in New England, Mr. Rossiter spent several years in other connections within the metalworking industry. In 1944, he was appointed New England sales manager, and in 1949, was named assistant to the vice-president, with offices in Hartford.

L. D. HOLLAND, assistant to the president and a member of the board of directors of E. F. Houghton & Co., Philadelphia, Pa., died on April 14 after a long illness, at the age of forty-six years. Mr. Holland had been connected with the company since 1927 as sales representative, Western Division sales manager, manager of research sales, and assistant general sales manager.

FAY HENRY WILLEY, founder and president of Willey's Carbide Tool Co., Detroit, Mich., died on May 6 at the age of fifty-three years. Mr. Willey was born in Weston, W. Va., on December 9, 1896. He was one of the pioneers in the development of the tungsten-carbide industry, and was also well known in the industrial diamond field.

Coming Events

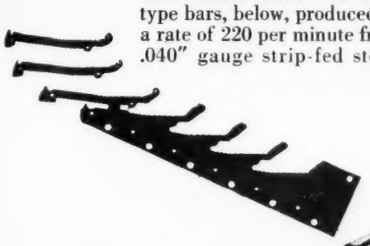
JUNE 5-7 — Thirty-fourth annual meeting of the AMERICAN GEAR MANUFACTURERS ASSOCIATION at the Homestead, Hot Springs, Va. Executive secretary, Newbold C. Goin, Empire Bldg., Pittsburgh 22, Pa.

JUNE 12-15—Thirty-seventh annual convention of the AMERICAN ELECTROPLATERS' SOCIETY and FOURTH INTERNATIONAL CONFERENCE ON ELECTRODEPOSITION (in collaboration with the Electrodepositors' Technical Society of Great Britain) at the Statler Hotel in Boston, Mass. For further information, address the American Electroplaters' Society, 473 York Road, Jenkintown, Pa.

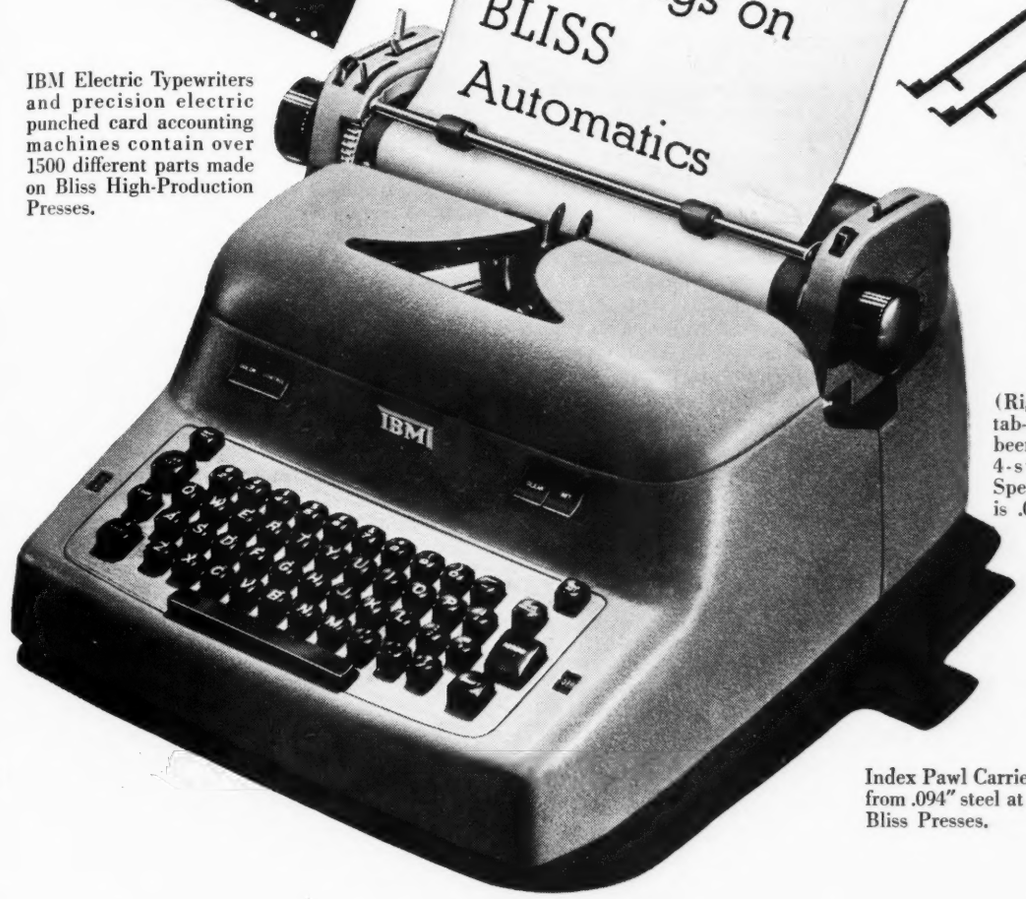
JUNE 19-23—Semi-annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the Statler Hotel in St. Louis, Mo. Secretary, Clarence

How IBM clicks off short-run stampings on BLISS Automatics

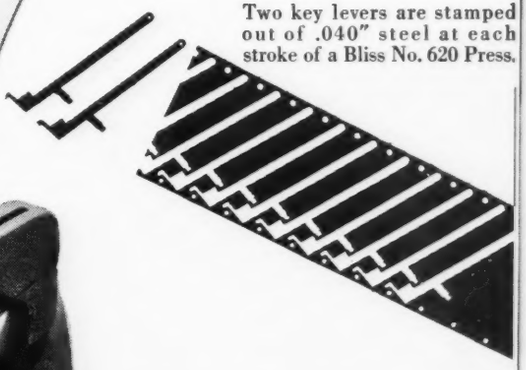
Spacing and hole sizes are held within .0005" on IBM type bars, below, produced at a rate of 220 per minute from .040" gauge strip-fed steel.



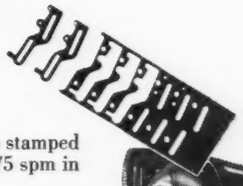
IBM Electric Typewriters and precision electric punched card accounting machines contain over 1500 different parts made on Bliss High-Production Presses.



Two key levers are stamped out of .040" steel at each stroke of a Bliss No. 620 Press.



(Right) Three to five million tab-keys of .048" steel have been stamped from the same 4-stage progressive die. Speed is 250 spm; tolerance is .001" in every dimension.



Index Pawl Carriers stamped from .094" steel at 175 spm in Bliss Presses.

Quick die changeover speeds output of 1500 different parts... production increased 25-30%

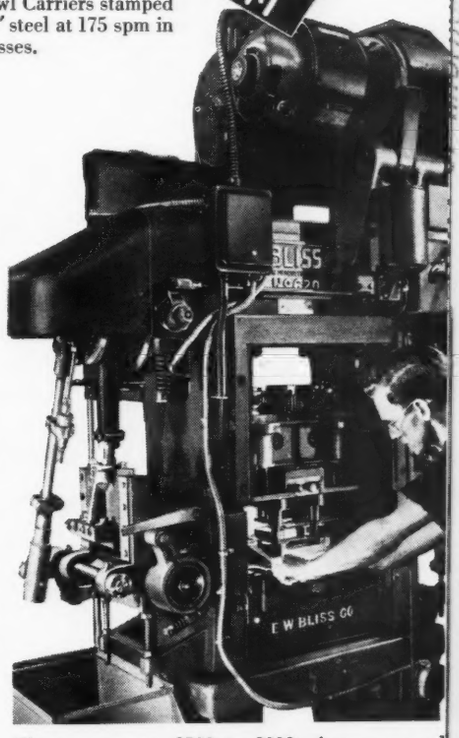
Die changeover is simple on Bliss High-Production Presses—takes less than 20 minutes per set-up at International Business Machine's Poughkeepsie, N. Y., plant. Then it's clock-work. IBM attributes stamping production increases of 25-30% to this factor and to the reduced handling of automatic operation compared to results with open back inclinables.

Turning out short production runs of over 1500 different parts during each quarterly manufacturing schedule is the job of five Bliss High-Production Presses. Low-tolerance part runs may be as little as 3,000 per set-up.

Die Life Doubled for IBM since Bliss High-Production Presses were installed at war's end. With one 4-stage progressive die they've already stamped out between 3 and 5 million typewriter tab keys from .048" steel to tolerances of .001" or less in every dimension, without appreciable die wear...and it's still going strong.

Hold Feeds to .003"... With Bliss Automatics IBM is also able to hold feeds to .003" allowing the die-maker in his design to reduce material scrap.

For long or short runs, from coiled or strip-fed stock, Bliss High-Production Presses can spell economy and efficiency for you, too. You'll get dependable (IBM hasn't required outside service in four years), easy-to-operate equipment that assures maximum output from both man and machine. Automatic feeds, indexing and ejecting features are available as required. Write today for catalog 27-B.



Short-run parts—2500 to 3000 pieces—are onl 10 to 15 minutes' work on this Bliss Press.

E. W. BLISS CO., TOLEDO 7, OHIO

Mechanical and Hydraulic Presses, Rolling Mills, Container Machinery

BLISS BUILDS MORE TYPES AND SIZES OF PRESSES THAN ANY OTHER COMPANY IN THE WORLD

MARQUETTE · BLISS · CONSOLIDATED · TOLEDO · BLISS BUILT

E. Davies, 29 W. 39th St., New York 18, N. Y.

JUNE 26-30—Annual meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS AND NINTH EXHIBIT OF TESTING APPARATUS at the Chalfonte-Haddon Hall, Atlantic City, N. J. Executive secretary, C. L. Warwick, 1916 Race St., Philadelphia 3, Pa.

SEPTEMBER 13-18—Twenty-seventh annual convention of the NATIONAL ASSOCIATION OF FOREMEN at the Hotel Statler in Buffalo, N. Y. Further information can be obtained by addressing the Association at its headquarters, 321 W. First St., Dayton 2, Ohio.

SEPTEMBER 18-22—FIFTH NATIONAL INSTRUMENT EXHIBIT of the INSTRUMENT SOCIETY OF AMERICA in the Memorial Auditorium, Buffalo, N. Y. Further information can be obtained from the Society at 921 Ridge Ave., Pittsburgh 12, Pa.

SEPTEMBER 26-29—IRON AND STEEL EXPOSITION, in conjunction with the annual convention of the ASSOCIATION OF IRON AND STEEL ENGINEERS, at the Cleveland Public Auditorium, Cleveland, Ohio. For further information, address the Association, 1010 Empire Bldg., Pittsburgh 22, Pa.

OCTOBER 18-20 — Annual national conference of the SOCIETY OF THE PLASTICS INDUSTRY, at New Ocean House, Swampscott, Mass. Further information can be obtained from William T. Cruse, executive vice-president, 295 Madison Ave., New York 17, N. Y.

OCTOBER 23-27—Fall meeting of the Metals Branch of the AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS in Chicago, Ill. National secretary, E. H. Robie, 29 W. 39th St., New York 18, N. Y.

OCTOBER 23-27—Annual meeting of the AMERICAN SOCIETY FOR METALS in Chicago, Ill. National secretary, W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.

OCTOBER 23-27—Annual meeting of the AMERICAN WELDING SOCIETY in Chicago, Ill. National secretary, J. G. Magrath, 33 W. 39th St., New York 18, N. Y.

OCTOBER—23-27 — Annual meeting of the SOCIETY FOR NON-DESTRUCTIVE TESTING in Chicago, Ill. National secretary, Philip D. Johnson, Skokie, Ill.

OCTOBER 23-27 — NATIONAL METAL CONGRESS and EXPOSITION at the International Amphitheater, Chicago, Ill. For further information, address W. H. Eisenman, managing director, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

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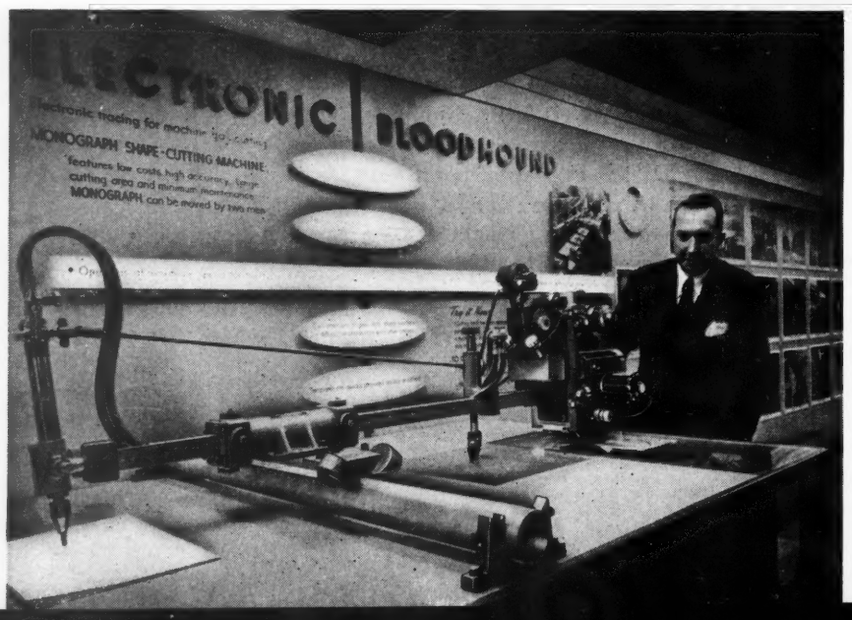
According to the American Electroplaters' Society, the bright chromium plate used on the exterior of last year's automobiles would coat a strip 3 feet in width stretching completely around the surface of the earth at the equator.

(Right) The "More Power to America Special," a ten-car exhibit train launched on a nation-wide tour by the Apparatus Department of the General Electric Co., is hauled by a 4500-H.P., two-unit Alco-GE Diesel-electric locomotive and is filled with exhibits of more than 2000 of the latest electric products, processes, and techniques. The stainless-steel coaches of the train were built by the Pullman Standard Car Mfg. Co.



(Left) One of the exhibits in the train's drives and controls section, which simulates accurate, automatic flame-cutting of metal, with a ball-point pen substituted for the flame cutter. The detection unit at the right automatically follows a pattern located beneath it and reproduces, through electronic signal processes, the identical pattern at the location on the left. The exhibit demonstrates how the device can be used to flame-cut irregular shapes from metal plates with such precise tolerances that further cutting is unnecessary